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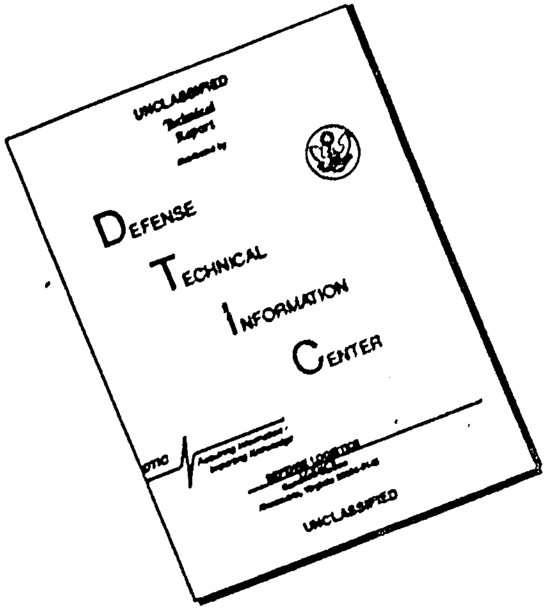


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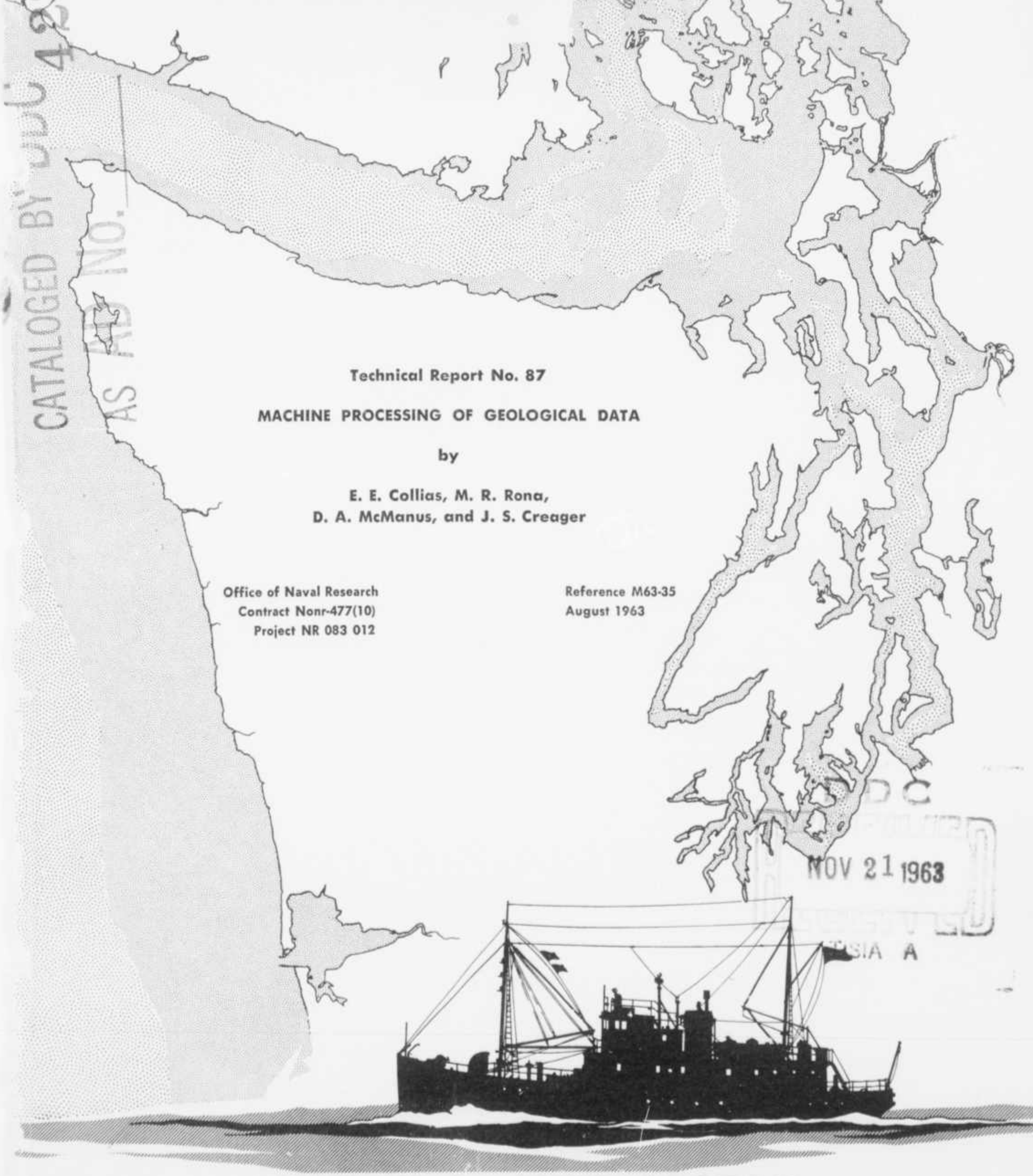

Technical Report No. 87

**MACHINE PROCESSING OF GEOLOGICAL DATA**

by

E. E. Collias, M. R. Rona,
D. A. McManus, and J. S. Creager

Office of Naval Research
Contract Nonr-477(10)
Project NR 083 012

Reference M63-35
August 1963



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RICHARD H. FLEMING
Chairman

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## ABSTRACT

Detailed instructions are given for using electronic computers to determine the statistics from sediment grain size analyses. The computer programs described are written specifically for the IBM 650 and IBM 709 computers, but they may be adapted for use on other computers.

Two types of programs are described. One gives order statistics such as Trask, Inman, and Folk and Ward values and is referred to as the "sediment description program", whereas the second program gives the moment measures of the grain size distribution.

Copies of the program decks in either symbolic or condensed form are available for a nominal charge.

# MACHINE PROCESSING OF GEOLOGICAL DATA

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## 1. INTRODUCTION

In recent years, machine processing of geological data of various types has become a standard tool for the geologist. This advancement is due to a recognition of the speed, accuracy and efficiency of modern electronic computers. Although geological data have been processed by electronic computers for some time, e.g., as an aid in mapping facies relationships of sedimentary rocks (Krumbein and Sloss, 1958) or in better describing associations of fossils (Imbrie, 1958), it is only recently that electronic computers have been used to perform more extensive computations on geological data. The diversity of these applications was displayed at the Research Committee Symposium "Geology Enters the Computer Age" which was held during the 47th Annual Meeting of the American Association of Petroleum Geologists in 1962 (see Bull. Am. Assoc. Petroleum Geologists, 1962, v. 46, pp. 256-284 for abstracts). The programs described in this report are examples of computer flexibility in obtaining descriptive statistics on sediment particle size distribution.

Several methods have been used to obtain a statistical description of particle size distribution of sediments. These methods can be classified into two categories: 1) those producing order statistics and 2) those producing moment measures. The order statistics include the graphic measures (percentile estimates) of Trask (Krumbein and Pettijohn, 1938), Inman (1952), and Folk and Ward (1957). The moment measures are classified as first moment about the origin, the mean; second moment about the mean, the standard deviation; the third moment about the mean, the skewness; and the fourth moment about the mean, the kurtosis. In addition to using the graphic approximations and correlative moment measures as methods of describing sediment particle sizes, use is often made of the relationship between the amount of sediment in various size grades, such as the sand to mud ratio.

Because calculations of these quantities could be performed faster and with greater reliability by an electronic computer than by hand, the programs described in this report were prepared for the IBM 650 and IBM 709 data processing systems. The program to compute the order statistics (known as the Sediment Description Program) was written originally for the IBM 650 magnetic drum processing machine, but later, when the IBM 709 data processing system became available, the program was rewritten and enlarged for use with this computer. A second program utilizing the 709 was prepared to compute the moment measures (Moment Measure Program). The 650 program can be adapted for any similar type of computer that has a minimum of a 2,000 ten-digit word memory and the 709 programs can be easily modified to run on any 8,000 bit computer such as the IBM 1401, 1620, CDC or similar computers.

In addition to the computers mentioned, the following IBM peripheral machines are used to prepare the data and tabulate the results: Manual keypunch, Model 10; automatic keypunch, Model 24 or 26; alphabetic

interpreter, Model 557; document originating machine, Model 519 (commonly known as a reproducing punch); sorter, Model 087; and an accounting machine, Model 407 (commonly known as a tabulator).

This report describes in detail the preparation of data for the computers, the operation of the 650 computer and the general procedure for use of the 709 computer, the tabulation of the results, the special features of the sediment description and moments measure programs. Any differences in programs for the two computers (650 and 709) are explained in the pertinent sections of this report.

## 2. DATA PROCESSING

### 2.1 Basic preparation of input data

2.1.1 Geological laboratory manipulation. The data supplied to the computers (hereafter called input data) are based upon the amount of the sample contained in the various size classes of a sediment sample. The amount of sample in a given size class is determined by accepted sieve and/or pipette analyses used in routine geological laboratory procedure (Krumbein and Pettijohn, 1938). For best results, it is desirable that the interval between size classes be kept as small as possible, preferably not exceeding one phi-unit[1]. More accurate results may be obtained by using $\frac{1}{4}$-phi-unit intervals. The smallest size class usually reported is 11 $\phi$.

The amount of sample within each size class is expressed as either: 1) a percentage of the total sample called the "fraction percentage", or 2) a weight in grams (to the nearest milligram) called the "fraction weight". To save time and to prevent errors in hand computations and transcription of the data, the latter value is preferred in preparing the data for the computer. When fraction weights are used, the "post analytical weight" must be specified. This weight is the total of all fraction weights in a given sample and is equal to the original sample weight, less any loss of sample during the laboratory manipulation of the sample. The maximum acceptable sample weight is 9,999 grams. However, the usual sample weight is less than 100 grams.

---

1 The common method of expressing sediment sizes is with the phi notation of Krumbein (1934). Phi ($\phi$) has been re-defined by McManus (in press) as:

$$\phi = - \log_2 \frac{\xi \text{ mm}}{\xi_o \text{ mm}} \tag{2.1}$$

where $\xi$ is the particle diameter in millimeters and $\xi_o$ is a standard diameter of 1 millimeter. The programs described in this report use phi-notation. If the particle sizes are expressed in millimeters, they should either be converted to phi-notation before submission to the computer or the programs modified to make these conversions prior to computations.

2.1.2 Preparation of summary sheets. Following laboratory analysis of the sample, the resulting data are transcribed on the summary sheet form illustrated in Figure 1. The use of this form facilitates keypunching of the data on Hollerith (IBM) cards. In preparing the summary sheet, two extra size classes are added to the laboratory data as follows: 1) an initial size class coarser than the largest size actually observed is added and indicated as containing zero fraction weight or zero fraction percentage of the sample; 2) a final size class is added to include all material finer than the smallest size class measured in the laboratory. All data fields[2] are to be filled. If no information is available for a field, zeros are inserted. Any field to be duplicated for the entire sample is indicated by a long vertical arrow in that column (see Figure 1).

## 2.2 Card Formats

2.2.1 Master Cards. One master card is prepared for each sample according to the format listed in Table 1. The master card includes all necessary identification, date of sample collection, geographic location from which the sample was obtained, etc. The card type[3] is indicated by the number zero punched in column 30 an "x-punch"[4] in card column 80. The data for the master card are taken from the upper right hand portion of the summary sheet.

The first twelve card columns are a set of numbers or letters to uniquely identify the sample. It is important that these columns be different for each sample as this identification is used on all cards (input, output and headers) pertaining to that sample. The EXTRA ID field is always a numeric[5] field, whereas the first ten card columns may be alphameric[5], and is used to identify subsamples. Because the sediment description program was developed for the study of recent marine sediments, some of the identification methods will differ from those used by geologists studying paleosediments. Thus, CRUISE NUMBER may be changed to WELL NUMBER, and LATITUDE-LONGITUDE may be replaced by TOWNSHIP-RANGE coordinates.

2.2.2 Detail Cards. One detail card is prepared for each size class contained in the sediment sample and is identified by the number "1" punched in column 30. Data for this type of card is taken from the body of the summary sheet and is punched according to the format presented in Table 2. The information punched on the detail cards

---

2 A field is a group of related card columns; i.e., the FRACTION WEIGHT field includes card columns 46 through 50.

3 There are a total of nine card formats used for input or output by the programs described in this report. Hence it is necessary to identify each type by a number punched in card column 30.

4 By "X-punch" it is understood that this is an overpunch in the 11-zone.

5 An ALPHAMERIC character is any legal Hollerith character such as numbers, letters, special characters or blanks. A NUMERIC field contains only numbers with a sign punched in a specified column of that field.

UW-DO-G 11 (REVISED)

**UNIVERSITY OF WASHINGTON — DEPARTMENT OF OCEANOGRAPHY — GEOLOGY SUMMARY SHEET**

| Vessel | Cruise | Station No. |
|---|---|---|
| Brown Bear | BB 236 | 010 |
| **Date of Analysis** | **Analyst** | |
| Jan 14, 1960 | Riley | |

MASTER CARD

| Cruise | | | | | Sample Number | | | Sample Type | | Extra I D No | | Date Sample Obtained Month | | Day | | Year | | Latitude | | | | | Longitude | | | | | OCT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B | B | 2 | 3 | 6 | 0 | 1 | 0 | 5 | 6 | 0 | 2 | 0 | 8 | 0 | 3 | 5 | 9 | 6 | 7° | 2 | 1 | .0' | 6 | 6 | 4 | 7 | .0' | 1 |
| 1 | | | | 5 | 6 | | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | | | | 23 | 24 | | | | 28 | 29 |

| CARD TYPE | 21 Depth | | | | | Not used | Post Analytical Weight | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 3 | 1 | 0 | ← → | 1 | 6 | .8 | 0 | 1 | 0 | 0 |
| 30 | 31 | | | | 35 | 36 … 50 | 51 | | | | 55 | 56 | |

| P.A. IN EXCESS OF 100 GRAMS | | | Core length | | | | | Remarks | CON-TROL |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 7 | 5 | 0 | | — |
| 58 | 59 | 60 | 61 | | | | 65 | 66 … 79 | 80 |

DETAIL CARD

Duplicate Column No. 1-29, 51-55, 59, 65, from Master Card
Columns 30 always 1. Column 58 always 0.

| Depth of sample in core | Phi size | Sign | Fractional Percent | Fractional Weight | FRACTIONAL WEIGHT OVER 100 GRAMS | Remarks |
|---|---|---|---|---|---|---|
| 31 35 | 36 39 | 40 | 41 45 | 46 50 | 56 57 | |
| 00310 | 02.00 | — | 00.00 | 00.000 | 00 | |
| ↓ | 01.00 | — | ↓ | 00.027 | ↓ | |
| | 00.00 | | . | 00.005 | | |
| | 01.00 | | . | 00.012 | | |
| | 02.00 | | . | 00.028 | | |
| | 03.00 | | . | 00.151 | | |
| | 04.00 | | . | 01.836 | | |
| | 05.00 | | . | 08.142 | | |
| | 06.00 | | . | 02.650 | | |
| | 07.00 | | . | 01.450 | | |
| | 08.00 | | . | 08.000 | | |
| | 09.00 | | . | 00.500 | | |
| | 10.00 | | . | 00.450 | | |
| | 11.00 | | . | 00.200 | | |
| | 12.00 | | . | 00.550 | | |
| | . | | . | . | | |
| | . | | . | . | | |
| | . | | . | . | | |
| | . | | . | . | | |
| | . | | . | . | | |
| | . | | . | . | | |
| | . | | . | . | | |

Fig. 1 Geology Data Summary Sheet

TABLE 1

FORMAT OF GEOLOGY MASTER CARD

| Field Number | Card Columns | Field Width | Information | Decimal Placement | Remarks |
|---|---|---|---|---|---|
| 1 | 1-5 | 5 | Cruise Number | XXXXX | Alphameric |
| 2 | 6-8 | 3 | Station Number | XXX | Alphameric |
| 3 | 9-10 | 2 | Sampler Type | XX | Alphameric, GR = gravity core; VV = Van Veen grab; PC = piston core, etc. |
| 4 | 11-12 | 2 | Extra Identification | XX | Numeric only, used to state more than one aliquot or sub-sample from the same core or grab sample |
| 5 | 13-18 | 6 | Date in order as Month/Day/Year | XXXXXX | |
| 6 | 19-23 | 5 | Latitude to the nearest 0.1 minute | XX° XX.X' | No compass direction, and no punctuation |
| 7 | 24-28 | 5 | Longitude to the nearest 0.1 minute with hundreds omitted | XX° XX.X' | No compass direction, and no punctuation |
| 8 | 29 | 1 | Octant in which geographic position occurs | X | See Figure 2 to determine the correct number. |
| 9 | 30 | 1 | Card Type | X | This is a zero for Master Cards. |
| 10 | 31-35 | 5 | Depth of sample from a core in millimeters from top of core | XXXXX | If the sample is from a grab, fill in with zeros. |
| 11 | 36-50 | 15 | Blank or used for other information | | |
| 12 | 51-55 | 5 | Post analytical weight in grams less 100 grams | XX.XXX | To the nearest milligram. If greater than 100 grams, see Field No. 14. |
| 13 | 56-58 | 3 | Not used | 000 | FILL IN WITH ZEROS! |
| 14 | 59-60 | 2 | Post-analytical weight in excess of 100 grams | XX | Maximum sample size = 9999 grams; if not used punch 00 |
| 15 | 61-65 | 5 | Core length in millimeters | XXXXX | Leave blank for grab sample |
| 16 | 80 | 1 | Control punch | "X" | Must be an "eleven" overpunch! |

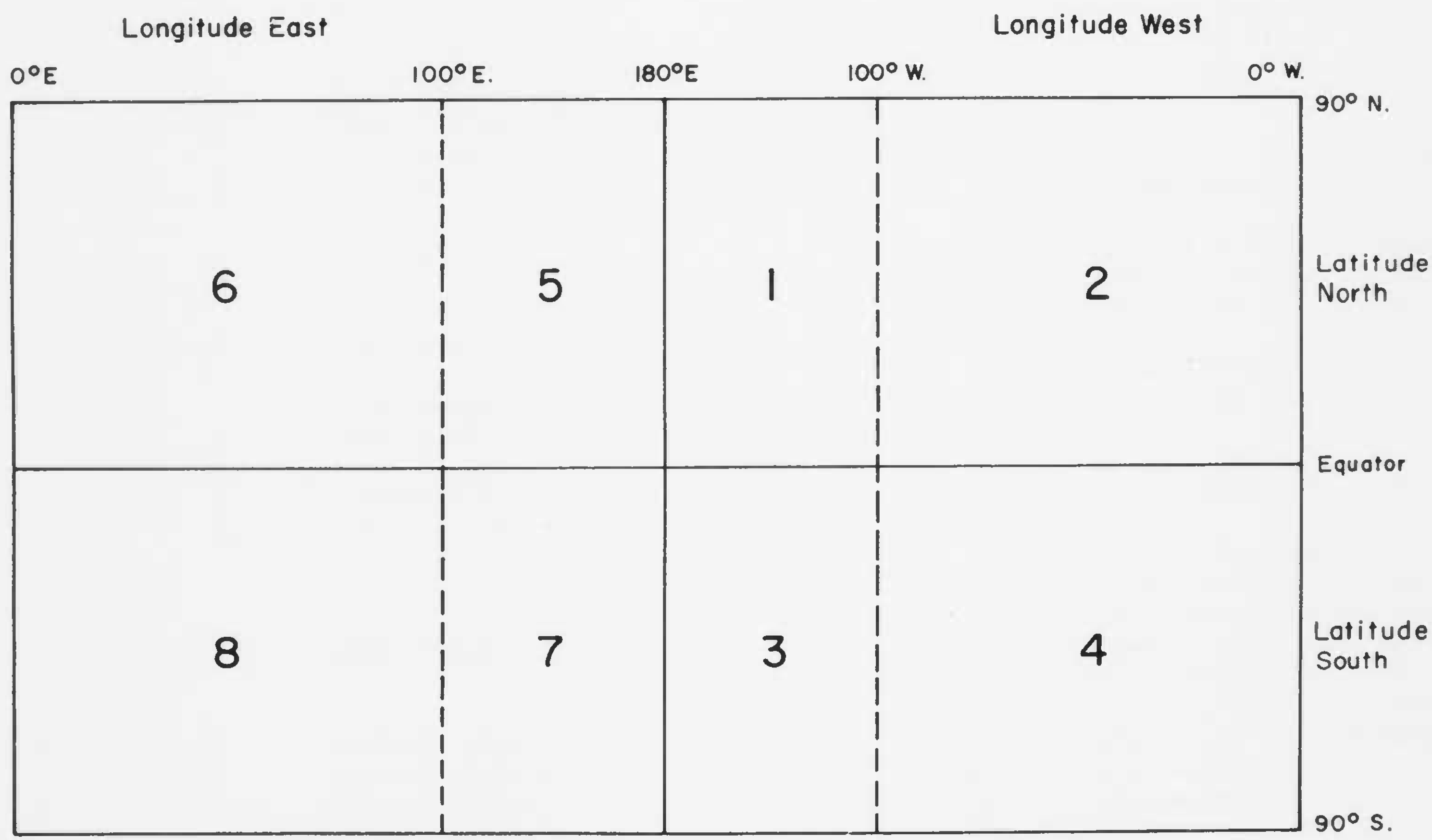


Fig. 2 Coding for Octant of Geographic Position

TABLE 2

FORMAT OF GEOLOGY DETAIL CARD

Note: Fields 1-8 and card columns 1-29 are the same as on the Master Card.

| Field Number | Card Columns | Field Width | Information | Decimal Placement | Remarks |
|---|---|---|---|---|---|
| 9 | 30 | 1 | Card Type | X | This is the number one (1) for detail cards. |
| 10 | 31-35 | 5 | Depth of sample | XXXXX | Duplicate from Master Card. |
| 11 | 36-39 | 4 | The size class in phi-units | XX.XX | To the nearest 0.01 phi-unit. |
| 12 | 40 | 1 | Sign of phi | X | Must also contain a zero in this column. Use an "eleven" over punch for minus (-) values. |
| 13 | 41-45 | 5 | Fraction-percentage of sample in this size class | XXX.XX | If not used, fill in with zeros. |
| 14 | 46-50 | 5 | Fraction-weight of sample in grams-100 grams contained in this size class | XX.XXX | If the weight is greater than 100 grams, list excess in Field 16. |
| 15 | 51-55 | 5 | Post analytical weight - 100 grams | XX.XXX | Duplicate from Master Card. |
| 16 | 56-57 | 2 | Fraction weight in excess of 100 grams | XX | Maximum sample size is under 10,000 grams. If not used, punch 00. |
| 17 | 58 | 1 | Not used | 0 | Must contain a zero. |
| 18 | 59-60 | 2 | Post-analytical weight in excess of 100 grams | XX | Duplicate from Master Card. |
| 19 | 61-65 | 5 | Core length in millimeters | XXXXX | Duplicate from Master Card. |
| 20 | 80 | 1 | Control punch | X | Blank except for last size class of each sample, which must be the number eight (8). |

includes the necessary identification (the same as card columns 1-29 on the master card), size class, fraction weight or fraction percentage, post analytical weight, and any other pertinent information in columns 61-79 of the master card. The last detail card of each sample must have the number "8" punched in column 80 to indicate the end of that particular sample.

The detail cards are used for all further computations and therefore must be complete and accurate before submission to the computer.

2.2.3 Output Cards. Six formats of output cards are produced by the 650 sediment description program, one for each type of computation (see section 3). Table 3 explains the format of the various output cards.

2.2.4 Header cards. Before tabulation of the output cards from the 650 computer, 15 header cards are inserted at selected intervals to properly identify the information being printed. Card columns 1 through 12 are the same as those on the master and detail cards for a given sample. Any alphameric information may be punched in columns 13 through 75 and be printed by the tabulator.

Column 76 is numbered 1 to 7 and indicates the type of output card the header card precedes. Columns 77 - 78 contain numbers to identify various header cards. In addition, column 78 may contain an "X-punch" if a double space is to follow that card. Column 79 may contain an "X-punch" if a page skip is desired before printing the card. Column 80 will always contain the number 9 as this activates the transfer print feature of the 407 tabulator. Table 4 presents the format of the header cards currently in use. Preparation of these cards and the assembly of the final print deck[6] is discussed in section 2.6.

## 2.3 Input deck[7] preparation

2.3.1 Keypunching data. The keypunching of the data as tabulated on the summary sheets (see section 2.1.2) may be done with either a Model 10 manual keypunch or with one of the automatic keypunches, Models 24 or 26. The Model 26 keypunch is the most desirable because it also prints, along the top edge of the card, the information being punched.

If the Model 10 punch is used, only sufficient identification is punched on the detail cards to properly identify them; this usually consists of part of Field 1 and all of Fields 2, 4 and 9, (see Table 2). Then the size class (Fields 11 and 12), and either fraction percentage (Field 13) or fraction weight (Fields 14 and 16) are punched. Finally, the master cards are prepared.

6 A print deck is a group of cards assembled in a specified order for final tabulation.

7 An input deck is a group of cards, in a given sequence, supplied to the computer that contains the necessary data from which computations are made.

TABLE 3

FORMAT OF OUTPUT CARDS

NOTE: All output cards have the same format in Fields 1-8 and 10 (card columns 1-29 and 31-35) as the Master Card. The Card Type (Field 9 card column 30) changes with the various output data. Minus (-) signs are punched over units in Fields 13-20. The characters in parenthese indicate decimal point location, and a preceding zero indicates that this position is always zero. Letters refer to explanatory notes at the end of the table.

| Field Number | Card Column | Individual-Size Classes | Phi-Sizes at Percentiles | Sand-Silt-Clay Relationships | Trask Values | Inman Values | Folk and Ward Values |
|---|---|---|---|---|---|---|---|
| 9 | 30 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11 | 36-39 | Size class in phi-units (XX.XX) | zeros | zeros -see A- | zeros | zeros | zeros |
| 12 | 40 | Sign of phi and a zero | Extrapolation Code -see B- | zero | zero | zero | zero |
| 13 | 41-45 | Fraction percentage (0XX.XX) | Phi at 5% (0XX.XX) | Larger-than-sand (0XX.XX) | First Quartile (XX.XXX) | Median Diameter (0XX.XX) | Mean Diameter (0XX.XX) |
| 14 | 46-50 | Accumulated percentage (XXX.XX) | Phi at 16% (0XX.XX) | Sand (0XX.XX) | Second Quartile (XX.XXX) | Mean Diameter (0XX.XX) | zeros -see C- |
| 15 | 51-55 | zeros | Phi at 25% (0XX.XX) | Silt (0XX.XX) | Third Quartile (XX.XXX) | Deviation (0XX.XX) | Deviation (0XX.XX) |
| 16 | 56-60 | t-value (0X.XXX) | Phi at 50% (0XX.XX) | Clay (0XX.XX) | Quartile Deviation (XX.XXX) | Skewness (0XX.XX) | Deviation Code (0000X) |

TABLE 3 (continued)

| Field Number | Card Column | Individual-Size Classes | Phi-Sizes at Percentiles | Sand-Silt-Clay Relationships | Trask Values | Inman Values | Folk and Ward Values |
|---|---|---|---|---|---|---|---|
| 17 | 61-65 | zeros | Phi at 75% (0XX.XX) | Sum of fraction percentage (XXX.XX) | $Log_{10}$ So (XX.XXX) | Second Skewness (0XX.XX) | Skewness (0XX.XX) |
| 18 | 66-70 | zeros | Phi at 84% (0XX.XX) | Sand-to-Mud Ratio (0XX.XX) | Skewness (XX.XXX) | Kurtosis (0XX.XX) | Skewness Code (0000X) |
| 19 | 71-75 | zeros | Phi at 95% (0XX.XX) | Shepard's Triangle code (00X0A) -see D- | zeros | zeros | Kurtosis (0XX.XX) |
| 20 | 76-80 | zeros | Method used to obtain percentiles (A B C D E) -see E- | zeros | zeros | zeros | Kurtosis Code (0000X) |

EXPLANATORY NOTES

A--Zeros mean that this field is not used but does have zeros punched in it.

B--If one of the percentile levels is extrapolated as stated in Table III, it will be coded as a minus number, so
-1 indicates that the 75% level was extrapolated. The 84% and 95% levels will contain 099.99.
-2 indicates that the 84% level was extrapolated. The 95% level will contain 099.99.
-3 indicates that the 95% level was extrapolated.

C--The IBM program prior to January, 1963 used this to indicate a first deviation suggested by Folk and Ward.

TABLE 3 (continued)

D--If X is a "1", the sample falls exactly upon a line in the Shepard triangle. "A" is the code from 1-10.

E--A "0" in positions A, B, or C indicates that the fraction percentage at 5, 16 or 25 was exactly equal to the values and the corresponding phi-size was listed without interpolation.

A "1" in positions A, B, or C indicates that the Aitkens method was used to obtain the phi-sizes at percentiles of 5, 16, and 25.

A "2" in positions A, B, or C indicates that the linear method was used to obtain the phi-sizes at percentiles of 5, 16, and 25.

Positions D and E are the combined methods for the 50 and 75% levels and the 84 and 95% levels, respectively. The number is the sum as follows:

| 50 and 84% levels | | 75 and 95% levels | |
|---|---|---|---|
| Exact value | = 0 | Exact value | = 0 |
| Aitkens method | = 1 | Aitkens method | = 1 |
| Linear method | = 2 | Linear method | = 4 |

Thus, a "2" in D or E indicates that the Aitkens method was used to compute both levels. A "6" indicates that the linear method was used to compute both levels, and so on.

TABLE 4

FORMAT OF HEADER CARDS

CARD COLUMN

```
0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

                      CRUISE           STATION             EXID            10J-9
            SAMPLER TYPE     DATE   /  /    LAT.   -  . N  LONG.    -  . W102 9
            DEPTH FROM TOP OF CORE       MM  LENGTH OF CORE       MM       10L 9
                                PHI   FRACTION ACCUMULATED                 204 9
                                SIZE   PERCENT   PERCENT                   20N 9
            PHI SIZES AT PERCENT LEVELS OF                                 306 9
               5         16        25        50        75        84      95  30P 9
            SAND. SILT. CLAY RELATIONSHIPS                                 408 9
            GRAVEL     SAND      SILT      CLAY      TOTAL  SAND/MUD  CLASS  40R 9
            TRASK VALUES                                                   510 9
               Q1        Q2        Q3        SO        LOG SO    SKG       51J 9
            INMAN VALUES                                                   612 9
             MEDIAN    MEAN      DEV.      SKEW.  2ND SKEW. KURT.          61L 9
            FOLK AND WARD VALUES                                           714 9
              MEAN               DEV.   TYPE      SKEW. TYPE      KURT. TYPE71N 9

0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

If an automatic keypunch is used, the master cards are prepared first and then the information contained in Fields 1 - 10, 15, 17, 18 and 19 is automatically duplicated on the detail cards for each sample.

2.3.2 Gangpunching detail cards. If in preparing detail cards the information to be duplicated from the master to detail cards was not done with an automatic keypunch, it will be necessary to use a reproducing punch to supply the missing information. Before using this machine, the proper master card must precede the detail card for each sample. This is done by hand or by using a sorter as follows: 1) Place the master cards followed by the detail cards in the read feed. 2) Sort on card columns 12, 11, 8, 7 and 6. If more than one cruise is included in the set of input data, sort on columns 5, 4, 3, 2 and 1. This prescribed order is important but any column known to contain the same information may be omitted from the sort. The resulting deck will contain a series of master cards followed by the matching detail cards.

The 519 reproducing punch is used as follows: 1) Insert a control panel wired according to Table 5; 2) set the X-SENSE brushes of both the read and punch feeds on card column 80 and connect to position 1; 3) place the cards in the punch unit; and 4) start the punch feed. After a stack of about three inches has been punched, 5) stop the machine; 6) place the punched cards in the read feed; 7) restart the machine and 8) continue adding cards to the punch feed and then to the read feed until finished. These last steps check the gang punching for machine errors.

2.3.3 Interpreting the cards. If a printing keypunch is not used, it is necessary to interpret portions of data on the cards using an alphabetic interpreter. A control panel for use with the model 557 alphabetic interpreter is described in Table 6. The ENTRY switch is set to position ONE for interpreting the detail cards.

2.3.4 Removal of master cards. Before proofreading the detail cards and/or preparing the input deck for the computer, it is necessary to remove the master cards by sorting on column 30. The master cards fall in the "zero" bin and the detail in the "one" bin.

2.3.5 Tabulation of input data for proofreading. The master cards are proofread from a tabulation made on the 407 using a "standard 80-80 board" that prints all the information as it appears on the cards. Most computer facilities have such a control panel prewired for the 407 tabulator.

The detail cards are proofread from a tabulation using the 407 with the control panel wired according to the description in Appendix 2. Place a blank card with the number "8" punched in column 80 in front of the deck to be tabulated in order to clear selected counters of the tabulator. Set the TRANSFER and FUNCTION switches to: TTNN TTTT. The proofsheet (shown in figure 3) is then checked against the original summary sheets and any errors are corrected. The blank card with an "8" in column 80 is removed immediately after tabulation.

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 0.000** |
| BB236 | 10 | 2 | 0310 | - 2.00 | 0.000 |
| BB236 | 10 | 2 | 0310 | - 1.00 | 0.027 |
| BB236 | 10 | 2 | 0310 | 0.00 | 0.005 |
| BB236 | 10 | 2 | 0310 | 1.00 | 0.012 |
| BB236 | 10 | 2 | 0310 | 2.00 | 0.028 |
| BB236 | 10 | 2 | 0310 | 3.00 | 0.151 |
| BB236 | 10 | 2 | 0310 | 4.00 | 1.836 |
| BB236 | 10 | 2 | 0310 | 5.00 | 8.142 |
| BB236 | 10 | 2 | 0310 | 6.00 | 2.650 |
| BB236 | 10 | 2 | 0310 | 7.00 | 1.450 |
| BB236 | 10 | 2 | 0310 | 8.00 | 0.800 |
| BB236 | 10 | 2 | 0310 | 9.00 | 0.500 |
| BB236 | 10 | 2 | 0310 | 10.00 | 0.450 |
| BB236 | 10 | 2 | 0310 | 11.00 | 0.200 |
| BB236 | 10 | 2 | 0310 | 12.00 | 0.550 |
| | | | | | 16.801* |
| | | | | | 16.801** |

Fig. 3 Proof Sheet of Example Geology Input Data

TABLE 5

Control Panel Wiring for Gangpunching Detail Cards

(for use with the IBM 519 Reproducer)

1) Read X to Read Pick-Up (H 1 to Q 3)

2) Read Pick-Up to Comp Pick-Up (Q 4 to U 4)

3) Jackplug Read X (N 3 to P 3)

4) Jackplug Comp Pick-Up (S 3 to T 3)

5) Punch X to Punch Direct Pick-Up (H 2 to K 3)

6) Jackplug Punch Direct Pick-Up (H 3 to J 3)

7) Jackplug GANG PUNCHING AND INTERPRETING BRUSHES to PUNCH NORMAL

1 - 5

9 - 10

13 - 29

31 - 35

51 - 55

59 - 65

8) Jackplug REPRODUCING BRUSHES to COMPARING UNIT

Same as # 7

9) Jackplug COMPARING AND TRANSCRIBING BRUSHES to COMPARING UNIT

Same as # 7

TABLE 6

Control Panel Wiring for Interpreting Input and Output Cards
(for the IBM 557 Interpreter)

| From Interpret Reading | | To Print Entry 1 | |
|---|---|---|---|
| 1 - 5 | (D 1 - 5) | 1 - 5 | (M 1 - 5) |
| 6 - 8 | (D 6 - 8) | 7 - 9 | (M 7 - 9) |
| 9 - 10 | (D 9 - 10) | 11 - 12 | (M 11 - 12) |
| 11 - 12 | (D 11 - 12) | 14 - 15 | (M 14 - 15) |
| 30 | (F 10) | 17 | (M 17) |
| 31 - 35 | (F 11 - 15) | 19 - 23 | (M 19 - 20; N 1 - 3) |
| 36 - 37 | (F 16 - 17) | 27 - 28 | (N 7 - 8) |
| 38 - 39 | (F 18 - 19) | 30 - 31 | (N 10 - 11) |
| 41 - 43 | (H 1 - 3) | 33 - 35 | (N 13 - 15) |
| 44 - 45 | (H 4 - 5) | 37 - 38 | (N 17 - 18) |
| 46 - 47 | (H 6 - 7) | 43 - 44 | (P 3 - 4) |
| 48 - 50 | (H 8 - 10) | 46 - 48 | (P 6 - 8) |
| 51 - 52 | (H 11 - 12) | 52 - 53 | (P 12 - 13) |
| 53 - 55 | (H 13 - 15) | 55 - 57 | (P 15 - 17) |
| 56 - 57 | (H 16 - 17) | 41 - 42 | (P 1 - 2) |
| 59 - 60 | (H 19 - 20) | 50 - 51 | (P 10 - 11) |
| 40 | (F 20) | to Int Col Split 1 - C | (E 21) |
| Int Col Split 11 - 12 | (D 21) | 26 | (N 6) |
| Int Emit Period | (W 21) | 29 | (N 9) |
| " " " | " | 36 | (N 16) |
| " " " | " | 45 | (P 5) |
| " " " | " | 54 | (P 14) |
| Suppression X jack plugged | | (P 21 - Q 21) | |
| Zero Print Control | | jack plugged 1 - 57 | |

| From Proof Reading | | To Proof Entry 1 | |
|---|---|---|---|
| 1 - 5 | (D 23 - 27) | 1 - 5 | (M 1 - 5) |
| 6 - 8 | (D 28 - 30) | 7 - 9 | (M 29 - 31) |
| 9 - 10 | (D 31 - 32) | 11 - 12 | (M 33 - 34) |
| 11 - 12 | (D 33 - 34) | 14 - 15 | (M 36 - 37) |
| 30 | (F 32) | 17 | (M 39) |
| 31 - 32 | (F 33 - 34) | 19 - 20 | (M 41 - 42) |
| 33 - 35 | (F 35 - 37) | 21 - 23 | (N 23 - 25) |
| 36 - 37 | (F 38 - 39) | 27 - 28 | (N 29 - 30) |
| 38 - 39 | (F 40 - 41) | 30 - 31 | (N 32 - 33) |
| 41 - 43 | (H 23 - 25) | 33 - 35 | (N 35 - 37) |
| 44 - 45 | (H 26 - 27) | 37 - 38 | (N 39 - 40) |
| 46 - 47 | (H 28 - 29) | 43 - 44 | (P 25 - 26) |
| 48 - 50 | (H 30 - 32) | 46 - 48 | (P 28 - 30) |
| 51 - 52 | (H 33 - 34) | 52 - 53 | (P 34 - 35) |
| 53 - 55 | (H 35 - 37) | 55 - 57 | (P 37 - 39) |
| 56 - 57 | (H 38 - 39) | 41 - 42 | (P 23 - 24) |
| 59 - 60 | (H 41 - 42) | 50 - 51 | (P 32 - 33) |

TABLE 6 (continued)

| From Proof Reading | | To Proof Entry 1 | |
|---|---|---|---|
| 40 | (F 32) | to Proof Col Split 1 - C | (H 21) |
| Proof Col Split 11 - 12 | (G 21) | 26 | (N 28) |
| Proof Emit Period | (W 43) | 29 | (N 31) |
| " " " | " | 36 | (N 38) |
| " " " | " | 45 | (P 27) |
| " " " | " | 54 | (P 36) |

| From Interpret Reading | | To Print Entry 2 | |
|---|---|---|---|
| 1 - 5 | (E 1 - 5) | 1 - 5 | (Q 1 - 5) |
| 6 - 8 | (E 6 - 8) | 7 - 9 | (Q 7 - 9) |
| 9 - 10 | (E 9 - 10) | 11 - 12 | (Q 11 - 12) |
| 11 - 12 | (E 11 - 12) | 14 - 15 | (Q 14 - 15) |
| 30 | (G 30) | 17 | (Q 17) |
| 31 - 32 | (G 31 - 32) | 19 - 20 | (Q 19 - 20) |
| 33 - 35 | (G 33 - 35) | 21 - 23 | (R 21 - 23) |

| From Proof Reading | | To Proof Entry 2 | |
|---|---|---|---|
| 1 - 5 | (E 23 - 27) | 1 - 5 | (Q 23 - 27) |
| 6 - 8 | (E 28 - 30) | 7 - 9 | (Q 29 - 31) |
| 9 - 10 | (E 31 - 32) | 11 - 12 | (Q 33 - 34) |
| 11 - 12 | (E 33 - 34) | 14 - 15 | (Q 36 - 37) |
| 30 | (G 32) | 17 | (Q 39) |
| 31 - 32 | (G 33 - 34) | 19 - 20 | (Q 41 - 42) |
| 33 - 35 | (G 35 - 37) | 21 - 23 | (R 23 - 25) |

2.3.6 Sorting cards before computations. Before the detail cards are submitted to the computer it is necessary to ascertain that the samples and size classes contained in these samples are in the correct order. An examination of the proofsheets will usually indicate whether or not the cards need sorting. If the cards have been dropped or otherwise mishandled, then it is imperative to make a sort.

Because of the presence of negative size classes, it is important to follow closely the following sorting procedure:

First, sort all cards on column 40, using ZONE sort and ZERO SUPPRESSION. The negative size classes will be found in the "11" bin and the positive size classes will fall in the "reject" bin. Keep the two decks separated!

Second, sort the negative size class cards on columns 39, 38, picking up the cards from the stackers in the order zero to nine. If these two columns are known to contain zeros, omit this step.

Third, sort on column 37, but this time pick up the cards from the stackers in the order nine to zero. Temporarily store the cards.

Fourth, sort the positive size class cards on columns 39, 38, 37, 36 in the usual manner and store separately. If columns 39 and 38 contain zeros, omit these sorts.

Fifth, place the negative class cards and sort on columns 12, 11, 10, 9, 8, 7 and 6. If the set of detail cards contains more than one cruise, it will be necessary to sort on columns 5, 4, 3, 2 and 1. Superfluous sorting may be eliminated if some of the columns are known to contain the same punches.

After sorting, the cards will be in order of increasing cruise number, increasing station number, increasing EXTRA ID; and, within each sample, the cards will be in increasing numerical order of size class, beginning with the largest negative class and ending with the largest positive class.

## 2.4 Procedure for job submission to the computers

2.4.1 650 procedure. If the computer facility to be used has a 650 computer, the chances are that it is a self-service type operation and thus will give the person interested in the final results more control over the computations. This is especially important if any errors in the input deck are detected by the computer. But if the computer facility is a closed-shop operation, it will be necessary to submit detailed instruction to the computer operator. In either case, the cards to be submitted must be in the following order:

1) Program deck number 0212 (309 cards in this program).
2) The detail cards in correct sequence (see section 2.3.6) and
3) An "end" card containing nines punched in all 80 columns.

Also, the computer facility will require the control panel for the 650 as described in Appendix 1.

2.4.2 709 Computer procedure. The following job submitting procedure applies specifically to the 709 computer facility at the University of Washington but is similar to other 709 facilities. The operation of this 709 computer facility is a closed shop operation and requires the deck to be prepared in the following order:

1. Run Request No. card.
2. I.D. card bearing the job number and name of the investigator
3. XEQ card
4. MAX TIME card
5. CARDS COLUMNS (FORTRAN symbolic deck if used)
6. SAVE tape card, if one desires to save the output tape
7. TAPE CARD OFFLINE, if punched cards output desired
8. LABEL
9. FORTRAN program deck 709-0213 (1018 cards)
10. Subroutines BTSNU, EXOR, XRND
11. END card
12. DATA card, followed by the
13. D A T A
14. END data card.

Note: If binary deck is used, omit cards nos. 5, 8, replace the FORTRAN deck (no. 9) by the binary deck of the main program and the binary decks of the subroutines.

## 2.5 Operation of the 650 computer

2.5.1 Console settings. The settings of the switches on the console of the 650 are as follows:

| | |
|---|---|
| Storage entry switches | - 7 0 1 9 5 2 2 0 0 0 + |
| Programmed | - STOP |
| Half cycle | - RUN |
| Address selection | - 0 2 0 0 |
| Control | - RUN |
| Display | - DISTRIBUTOR |
| Overflow | - STOP |
| Error | - STOP |

2.5.2 Preparation of the read punch unit. Before the computer is started, a control panel, as described in Appendix I, is inserted into the read-punch unit. The drum clear card and program deck are placed in the read feed followed by the detail cards. The desired type of blank cards are placed in the punch feed. It is usually not possible to put in all the cards to be read or punched at one time; therefore, do not overfill either feed but rather add cards as necessary to keep both feeds about two-thirds full.

2.5.3 Starting the computer. The 650 is started by depressing the control buttons in the following order: COMPUTER RESET, PROGRAM START, READ FEED START and PUNCH FEED START. The first card will be read

and the read feed stop for about 6 seconds before the remaining program cards are read. After the program has been read into memory, there will be another pause of about three seconds before the first sample is read. The samples will then be read with about five second pauses between each set unless the machine stops for some type of error.

2.5.4 Programmed stops. There are two programmed stops that might occur if data containing errors are submitted to the computer. Both of these stops will display the same information in the upper and lower accumulator, the distributor, and the program register. Hence, any of the four left hand positions of the DISPLAY switch will indicate the error. These error stops appear on the DISPLAY lights as:

(a) 0 1 1 9 9 9 0 2 0 0 indicating no zero percent card for that sample.
(b) 0 1 1 6 6 6 0 2 0 0 indicating cards not in order of increasing size class.

In either case, the computer may be restarted as follows:

First, remove the cards that have not yet been read from the READ FEED and place them on top of the read-feed unit.

Second, remove the cards already read from the READ FEED and keep them in a separate place.

Third, depress the READ FEED START key until all cards are run out of the READ FEED.

Fourth, isolate the incorrect sample by observing the identifying code as interpreted on the upper-left side of the card. It may be necessary to take cards from both stacks of cards removed from the READ FEED in order to reconstitute the sample.

Fifth, replace the remaining unread cards in the READ FEED and depress the following keys:

(a) READ FEED START
(b) PROGRAM START
(c) PUNCH FEED START

Sixth, while the computer is processing the remaining samples, carefully examine the incorrect sample to (a) locate the zero-percent card, and/or (b) restore the correct sequence of size class. In either case, it will be necessary to correct the detail cards before re-computing.

Thus, it is useful to have a copy of the original summary sheets at the computer in order to make the corrections at the computer facility.

2.5.5 Other error stops. The other sources of error stops are usually due to mispunched detail cards. The most common error is a missing zero-punch in column 40 (see Table 2). When this error occurs,

the lights labeled DISTRIBUTOR and ACCUMULATOR will be "ON". If this happens, set the DISPLAY switch to DISTRIBUTOR and look at the righthand column of the DISPLAY lights; they will be "OFF" and the ADDRESS lights will read 0 0 0 5. Other punching errors will be indicated by either blank positions in the DISPLAY lights or by more than two lights being "ON" in each set of lights. Before restarting the computer, record the information in the DISPLAY lights with the DISPLAY switch in the DISTRIBUTOR position, and the ADDRESS light indication; then remove the incorrect sample as described in section 2.5.4, and restart the computer as follows:

1. set the control switch to MANUAL
2. depress COMPUTER RESET
3. set the control switch to RUN
4. depress PROGRAM START
5. depress READ FEED START
6. depress PUNCH FEED START

Two other conditions will cause the computer to stop and are indicated by the INPUT-OUTPUT light "ON".

If the OPERATION lights read 7 0, the read feed either is full or all the cards except the last three have been read. In the first case remove the used cards from the READ FEED and depress READ FEED START. Otherwise, depress the END OF FILE key. If the OPERATION lights read 7 1, the punch hopper is either full or more blank cards need to be added. If the punch hopper if full, remove the punched cards and depress the PUNCH FEED START. Or in the latter case, add more blank cards and then depress the PUNCH FEED START.

## 2.6 Output deck manipulation

2.6.1 Interpret output cards. The output cards from the computer are interpreted using the same control panel as used in section 2.3.3 (see Table 6) but the ENTRY switch is set to position TWO.

2.6.2 Header card preparation. The header cards (described in section 2.2.4) are prepared from the master cards as follows:
1) A sufficient quantity of each of the 15 types of header cards are gangpunched in advance using an 80-80 gangpunch panel[8] in the reproducer.
2) Header cards numbered 4 through 15 are prepared individually by reproducing the information from columns 1 through 12 of the master cards into columns 1 through 12 of each of the header cards. This is done by running each of the twelve different header cards separately with the master cards using the control panel as described in Table 7.
3) Header cards 1, 2 and 3 require more complex control panel wiring. For header card number 1, use the wiring as described in Table 8, for header card number 2, use Table 9 and for header card number 3, use

8 This type of control panel will make an exact copy of the card to be duplicated and is available prewired at most computer facilities.

Table 10. When this step is completed, there will be fifteen header cards for each master card.

2.6.3 Assembly of print deck. The print deck is assembled, using the sorter as follows: 1) Place the header cards in the sorter with header card number 1 first followed by the remaining header cards in numerical order and sort on column 76. 2) Without removing the header cards from the bins, unless the bins are full, place the output deck in the sorter and sort on column 30. 3) Sort the entire deck on columns 12, 11, 10, 9 etc. to 1. Unnecessary sorting may be avoided if the cards are known to contain the same information in any of the columns. The print deck is now ready for tabulation.

2.6.4 Tabulation of the print deck. The print deck is tabulated using the 407 tabulator with the control panel described in Appendix II with all operation switches in the NORMAL position. The final tabulation may be made on single or multiple part paper, on fluid duplicator stencils or on paper masters for offset printing such as the Multilith process. An example of the finished tabulation is shown in Figure 4.

TABLE 7

Control Panel Wiring for Preparation of Header Cards
4 through 15 from Master Cards
(For use with 519 Reproducer)

1) Jackplug GANG PUNCHING AND INTERPRETING BRUSHES to COMPARING UNIT 1 - 12

2) Jackplug REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP 1 - 12

3) Jackplug COMPARING AND TRANSCRIBING BRUSHES to COMPARING UNIT 1 - 12

4) Jackplug Reproducing (1) (A 1 - B 1)

TABLE 8

Control Panel Wiring for Preparation of Header Card No. 1 from Master Cards
(For Use with 519 Reproducer)

1) Jackplug GANGPUNCHING AND INTERPRETING BRUSHES to COMPARING UNIT 1 - 12

2) Jackplug REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP 9 - 10

3) Intercolumn split REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP

| | | | | |
|---|---|---|---|---|
| 1 | to | 1 | and | 31 |
| 2 | to | 2 | and | 32 |
| 3 | to | 3 | and | 33 |
| 4 | to | 4 | and | 34 |
| 5 | to | 5 | and | 35 |
| 6 | to | 6 | and | 49 |
| 7 | to | 7 | and | 50 |
| 8 | to | 8 | and | 51 |
| 11 | to | 11 | and | 67 |
| 12 | to | 12 | and | 68 |

4) Jackplug COMPARING AND TRANSCRIBING BRUSHES to COMPARING UNIT 1 - 12

5) Jackplug Reproducing (1) (A 1 - B 1)

TABLE 9

Control Panel Wiring for Header Card No. 2 from Master Cards
(For Use with 519 Reproducer)

1) Jackplug Reproducing (1) (A 1 - B 1)

2) Jackplug GANG PUNCHING AND INTERPRETING BRUSHES to COMPARING UNIT 1 - 12

3) Jackplug REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP 1 - 8; 11 - 12

4) Intercolumn Split REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP

| | | | | |
|---|---|---|---|---|
| 9 | to | 9 | and | 26 |
| 10 | to | 10 | and | 27 |

5) REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP

| | | |
|---|---|---|
| 13 - 14 | to | 35 - 36 |
| 15 - 16 | to | 38 - 39 |
| 17 - 18 | to | 41 - 42 |
| 19 - 20 | to | 50 - 51 |
| 21 - 22 | to | 53 - 54 |
| 23 | to | 55 |
| 24 - 25 | to | 68 - 69 |
| 26 - 27 | to | 71 - 72 |
| 28 | to | 74 |

TABLE 10

Control Panel Wiring for Header Card No. 3 from Master Cards
(For Use with 519 Reproducer)

1) Jackplug GANG PUNCHING AND INTERPRETING BRUSHES to COMPARING UNIT 1 - 12

2) Jackplug REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP 1 - 12

3) REPRODUCING BRUSHES to PUNCH DIRECT REPRODUCING MS & GP

| | | |
|---|---|---|
| 31 | to | 36 |
| 32 | to | 37 |
| 33 | to | 38 |
| 34 | to | 39 |
| 35 | to | 40 |
| 61 | to | 60 |
| 62 | to | 61 |
| 63 | to | 62 |
| 64 | to | 63 |
| 65 | to | 64 |

4) Jackplug COMPARING AND TRANSCRIBING BRUSHES to COMPARING UNIT 1 - 12

5) Jackplug Reproducing (1) (A 1 - B 1)

CRUISE BB 236 STATION 010 EXID 02

SAMPLER TYPE SG DATE 08/03/59 LAT. 67-21.0N LONG. 166-47.0W
DEPTH FROM TOP OF CORE 00310 MM LENGTH OF CORE 01750 MM

| PHI SIZE | FRACTION PERCENT | ACCUMULATED PERCENT |
|---|---|---|
| -2.00 | 0.00 | 0.00 |
| -1.00 | 0.16 | 0.16 |
| 0.00 | 0.03 | 0.19 |
| 1.00 | 0.07 | 0.26 |
| 2.00 | 0.17 | 0.43 |
| 3.00 | 0.90 | 1.33 |
| 4.00 | 10.93 | 12.26 |
| 5.00 | 48.46 | 60.72 |
| 6.00 | 15.77 | 76.49 |
| 7.00 | 8.63 | 85.12 |
| 8.00 | 4.76 | 89.88 |
| 9.00 | 2.98 | 92.86 |
| 10.00 | 2.68 | 95.54 |
| 11.00 | 1.19 | 96.73 |
| 12.00 | 3.27 | 100.00 |

PHI SIZES AT PERCENT LEVELS OF

| 5 | 16 | 25 | 50 | 75 | 84 | 95 | |
|---|---|---|---|---|---|---|---|
| 3.74 | 4.06 | 4.17 | 4.63 | 5.87 | 6.83 | 9.73 | 11122 |

SAND. SILT. CLAY RELATIONSHIPS

| GRAVEL | SAND | SILT | CLAY | TOTAL | SAND/MUD | CLASS |
|---|---|---|---|---|---|---|
| 0.16 | 12.09 | 77.63 | 10.12 | 100.00 | 0.14 | 4 |

TRASK VALUES

| Q1 | Q2 | Q3 | SO | LOG SO | SKG |
|---|---|---|---|---|---|
| 0.056 | 0.041 | 0.017 | 1.805 | 0.257 | 0.76 |

INMAN VALUES

| MEDIAN | MEAN | DEV. | SKEW. | 2ND SKEW. | KURT. |
|---|---|---|---|---|---|
| 4.63 | 5.44 | 1.39 | 0.59 | 1.52 | 1.16 |

FOLK AND WARD VALUES

| MEAN | DEV. | TYPE | SKEW. | TYPE | KURT. | TYPE |
|---|---|---|---|---|---|---|
| 5.17 | 1.60 | 4 | 0.65 | 5 | 1.44 | 3 |

Fig. 4 Example of Output from the Sediment Description Programs

## 3. SEDIMENT DESCRIPTION PROGRAMS (Nos. 0212 and 0213)[9]

### 3.1 General description

The Sediment Description Programs provide a variety of data on sediment texture, including percentages of gravel, sand, silt, and clay, the sand/mud ratio, and three end-member textural class designations; the phi-sizes at selected percentile levels, and the percentile measures referred to as Trask values, Inman values, and Folk and Ward values. The main differences between the two programs is that 0212 is written for the IBM 650 computer and produces only card output, whereas 0213 is written for the IBM 709 and produces a written output. The flow chart for these programs is presented in Figure 5.

### 3.2 Computer program coding

The 650 computer program was coded using SOAP-H[10] and is listed in Appendix 3. The 709 program was coded in FORTRAN II and is listed in Appendix 4.

### 3.3 Restrictions

Although restrictions have been mentioned in preceding sections, they will be summarized here: 1) The 650 program will accept only 49 size classes within any given sample, whereas the 709 program will accept up to 100 size classes. 2) Any values missing from the input data up to card column 60 must be filled in with zeros. This is particularly true of detail card column 40, the sign of phi, which must contain a zero-punch as well as the sign. 3) The first detail card of each sample must be a "zero percent" card.

### 3.4 Subroutines

The 650 program utilizes the following subroutines:

1) Exponential, IBM File Number 3.1.004, computes $e^X$ where X has a range from - 16.11 to 23.02585092,

---

9 0212 is the code number given to the IBM 650 Sediment Description Program. 0213 is the code number given to the IBM 709 Sediment Description Program.

10 SOAP-H was written by personnel from the University of Washington, Research Computer Laboratory. It includes features such as preparation of a condensed program deck and sequential number of location, neither of which are found in SOAP II.

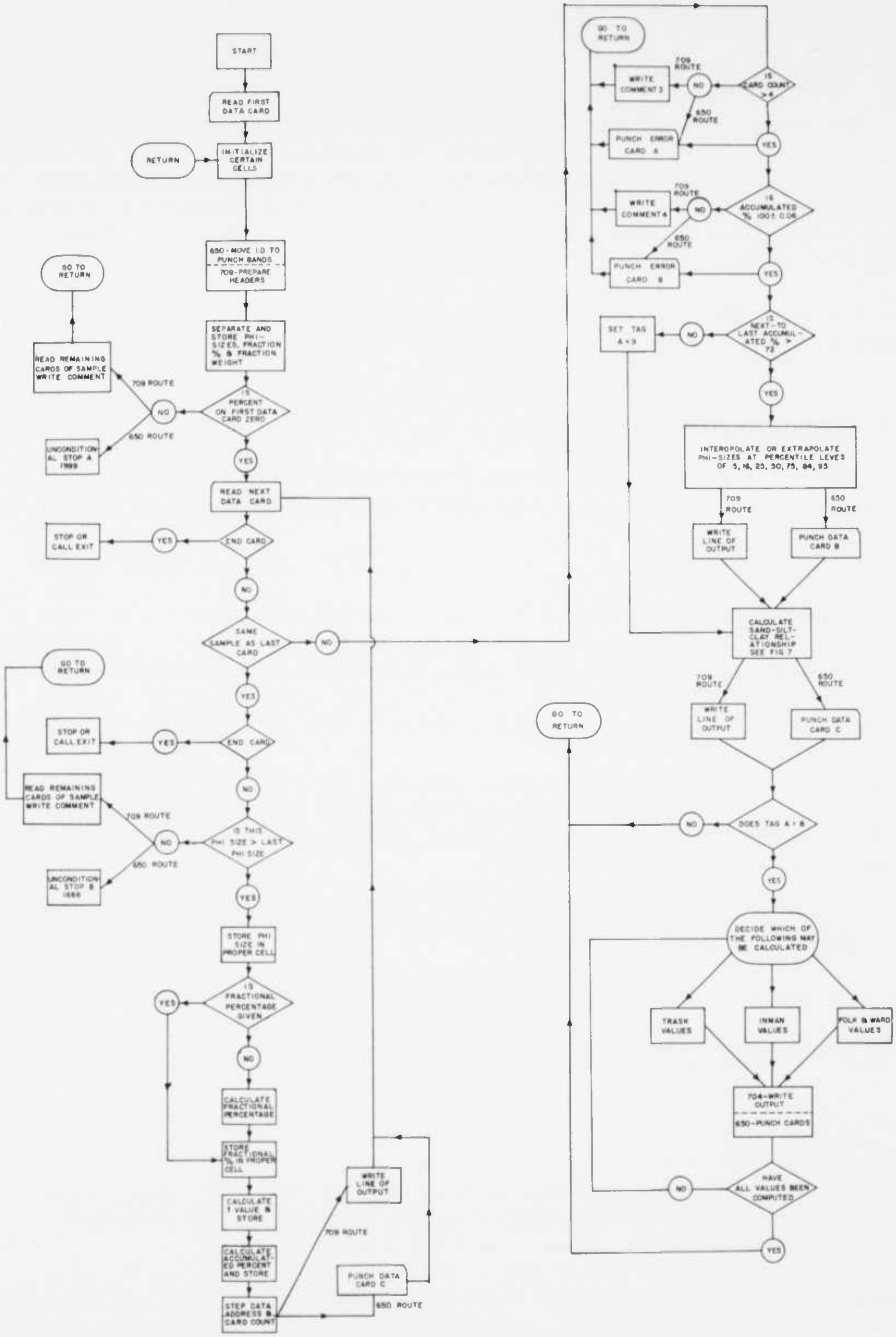


Fig. 5 Flow Chart for Sedimentary Description Programs

2) Log base 10 or base E-fixed point, University of Washington Research Computer number 5002, and

3) Square root - fixed point, IBM Technical Newsletter No. 9, pp. 30-33.

These subroutines have been incorporated into the 650 program and are not required as separate programs. The 709 program utilizes the following subroutines not incorporated in the FORTRAN master tape:

BTSNU (see Appendix 6)
EXOR (see Appendix 7)
XRND (see Appendix 8)

### 3.5 Conversion of input data

Both the 650 and 709 programs process one sample at a time. The first detail card read by the program causes initialization of selected words in memory. The identification on this card is moved to the punch bands by the 650 program whereas the 709 program prepares the header information. Next, the fraction percentage and fraction weight are checked to ascertain that they are both zero. If not, an error statement is prepared and executed (SOAP-H card no. 111 and FORTRAN statement no. 1990). Such errors stop the 650 computer (see section 2.5.4), but the 709 program will read the remaining cards of this sample and check for other errors as described in the following paragraphs. However, no further computations will be performed and the sample will ultimately be rejected.

Successive detail cards are read until the end of the sample has been reached. As each detail card is read, the size class is checked to insure that the size classes are in order of ascending phi-size. If they are not, the second error statement is prepared and executed (SOAP-H card no. 165 and FORTRAN statement no. 1666). The data on the detail cards are then scanned to determine whether fraction percentage or fraction weight is punched. If the fraction weight is punched, the fraction percentage is calculated from the equation:

$$\text{fraction percentage} = \frac{\text{fraction weight X 100}}{\text{post analytical weight}} \qquad (3.1)$$

Next, the sum of the fraction percentages is accumulated from the first detail card of each sample to and including the size class being processed. From this accumulated percentage, a t-value[11] is determined

11 The t-value is the area under a normal distribution curve expressed in standard deviation units from the center point of 50% of the value of interest. The sign attached to that value is (-) from 0 to 50% and (+) from 50 to 100%. The minimum t-value is -4.090 for 0% and the maximum + 4.090 for 100%: e.g., for an accumulated percentage of 34.83, the t-value is: -0.390.

by TABLE LOOK UP. The computer scans a table of accumulated percentage values and interpolates for the correct t-values. If the accumulated percentage values are closely spaced, the accuracy of the interpolation is better than 0.001 t-units. The t-values are used to determine the phi-sizes at percentile levels of 5, 16, 25, 50, 75, 84 and 95. This is the equivalent of plotting by hand, on normal probability paper, the size-class against accumulated percentage.

After all detail cards for a given sample have been read, the final accumulated percentage must be 100.00 ± 0.06, or the sample is rejected and the third error statement prepared and executed. (SOAP card no. 303 and FORTRAN statement no. 100). If this error occurs, the program bypasses all further computations and selects the next sample to restart the process. If the data pass the above test, the next-to-last size class is then checked to ascertain that the accumulated percentage at this level (called the next-to-last accumulated percentage) is greater than 72. If this is not the case, only the sand-silt-clay relationships are calculated.

### 3.6 Interpolation of phi sizes at selected percentile levels

The phi-sizes at percentile levels of 5, 16, 25 and 50 are computed from the t-values by two interpolation routines; a) the four-point Aitkens method (Milne, 1948), and b) the two-point linear method. Then, depending upon the value of the next-to-last accumulated percentage the phi-sizes at percentile levels of 75, 84 and 95 are either interpolated or extrapolated as explained in Table 11.

The equations for the four-point Aitkens method of interpolation by successive iterations are as follows:

$$P_{1,2} = \left[(Y_1)\ (X_2 - X) - (Y_2)\ (X_1 - X)\right] \div (X_2 - X_1) \quad (3.2)$$

$$P_{1,3} = \left[(Y_1)\ (X_3 - X) - (Y_3)\ (X_1 - X)\right] \div (X_3 - X_1) \quad (3.3)$$

$$P_{1,4} = \left[(Y_1)\ (X_4 - X) - (Y_4)\ (X_1 - X)\right] \div (X_4 - X_1) \quad (3.4)$$

$$P_{1,2,3} = \left[(P_{1,2})\ (X_3 - X) - (P_{1,3})\ (X_2 - X)\right] \div (X_3 - X_2) \quad (3.5)$$

$$P_{1,2,4} = \left[(P_{1,2})\ (X_4 - X) - (P_{1,4})\ (X_2 - X)\right] \div (X_4 - X_2) \quad (3.6)$$

$$Y_A = \left[(P_{1,2,3})\ (X_4 - X) - (P_{1,2,4})\ (X_3 - X)\right] \div (X_4 - X_3) \quad (3.7)$$

TABLE 11

PERCENTILE LEVELS AND STATISTICAL RESULTS COMPUTED ACCORDING TO VALUE OF NEXT-TO-LAST ACCUMULATED PERCENT

| Value of Next-to-last Accumulated Percent | | Highest Percentile Level to be Computed | Method used | Statistical Values Computed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Sand-Silt-Clay | Trask | Inman A | Inman B | Folk & Ward |
| greater than | less than | | | | | | | |
| --- | 72 | none | --- | X | | | | |
| 72 | 75 | 75 | extrapolation | X | X | | | |
| 75 | 81 | 75 | interpolation | X | X | | | |
| 81 | 84 | 84 | extrapolation | X | X | X | | |
| 84 | 92 | 84 | interpolation | X | X | X | | |
| 92 | 95 | 95 | extrapolation | X | X | X | X | X |
| 95 | 100.06 | 95 | interpolation | X | X | X | X | X |
| 100.06 | - | sample rejected | | | | | | |

X indicates that this value is computed

where $X_1$, $X_2$, $X_3$ and $X_4$ are the t-values corresponding to the phi-sizes $Y_1$, $Y_2$, $Y_3$ and $Y_4$. X is the t-values at the desired percentile level and $Y_A$ is the desired answer.

The second method is a linear two-point interpolation routine of the form

$$Y_L = \left[(X - X_1) \quad (Y_2 - Y_1)\right] \div (X_2 - X_1) + Y_1 \tag{3.8}$$

where $X_1$ and $X_2$ are t-values corrsponding to the phi-sizes $Y_1$ and $Y_2$. X is the t-value at the desired percentile level and $Y_L$ is the desired value.

If $Y_A$ and $Y_L$ agree within 0.20 phi-units and if the Aitkens value is between the two adjacent size classes, the Aitkens value is used in preference to the linear result. This process corresponds to drawing a smoothed curve on the normal probability paper rather than a series of straight lines. After the last percentile level has been calculated, a statement of the results is prepared including a code to indicate the method used in obtaining any particular percentile level.

### 3.7 Sand-silt-clay relationships

After the selected percentile levels have been obtained, the sand-silt-clay relationships are computed as follows:

1. The weight percentage of material that will not pass through the-1 $\phi$ sieve is listed as gravel.
2. Material that will pass through the-1 $\phi$ sieve but is retained by the 4 $\phi$ sieve is listed as sand.
3. Material finer than 4 $\phi$, but coarser than 9 $\phi$ is listed as silt.
4. All material finer than 8 $\phi$ is listed as clay.
5. The ratio of material coarser than 5 $\phi$ to that finer than 4 $\phi$ is computed to give a sand-to-mud ratio, and
6. The position of the sample in the triangular classification of Shepard (1954) is coded according to Figure 6.

The position of the sample on the Shepard triangular diagram was determined from the percentage of sand-gravel, silt and clay present in the sample. The flow chart for this selection is shown in Figure 7. If the sample happens to fall upon a line, this is indicated in the output by the number "one" preceeding the position code.

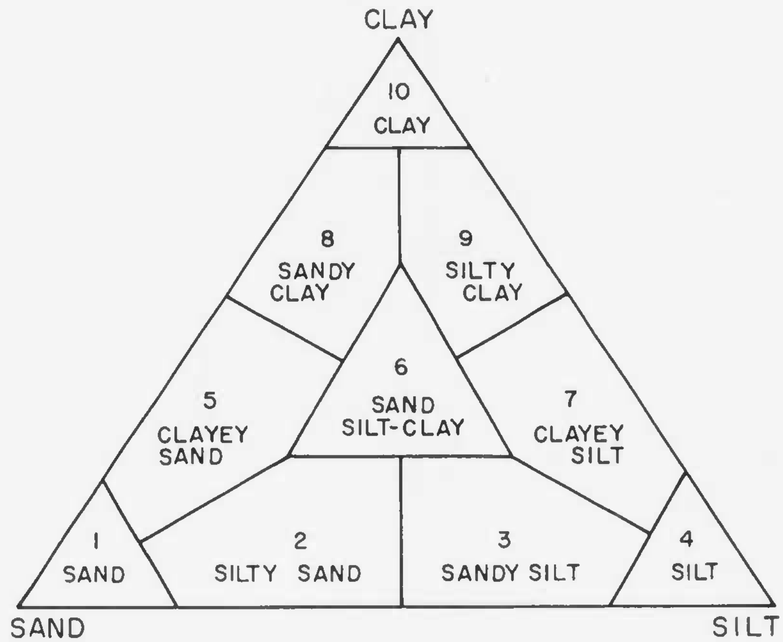


Fig. 6 Triangular Classification According to Shepard

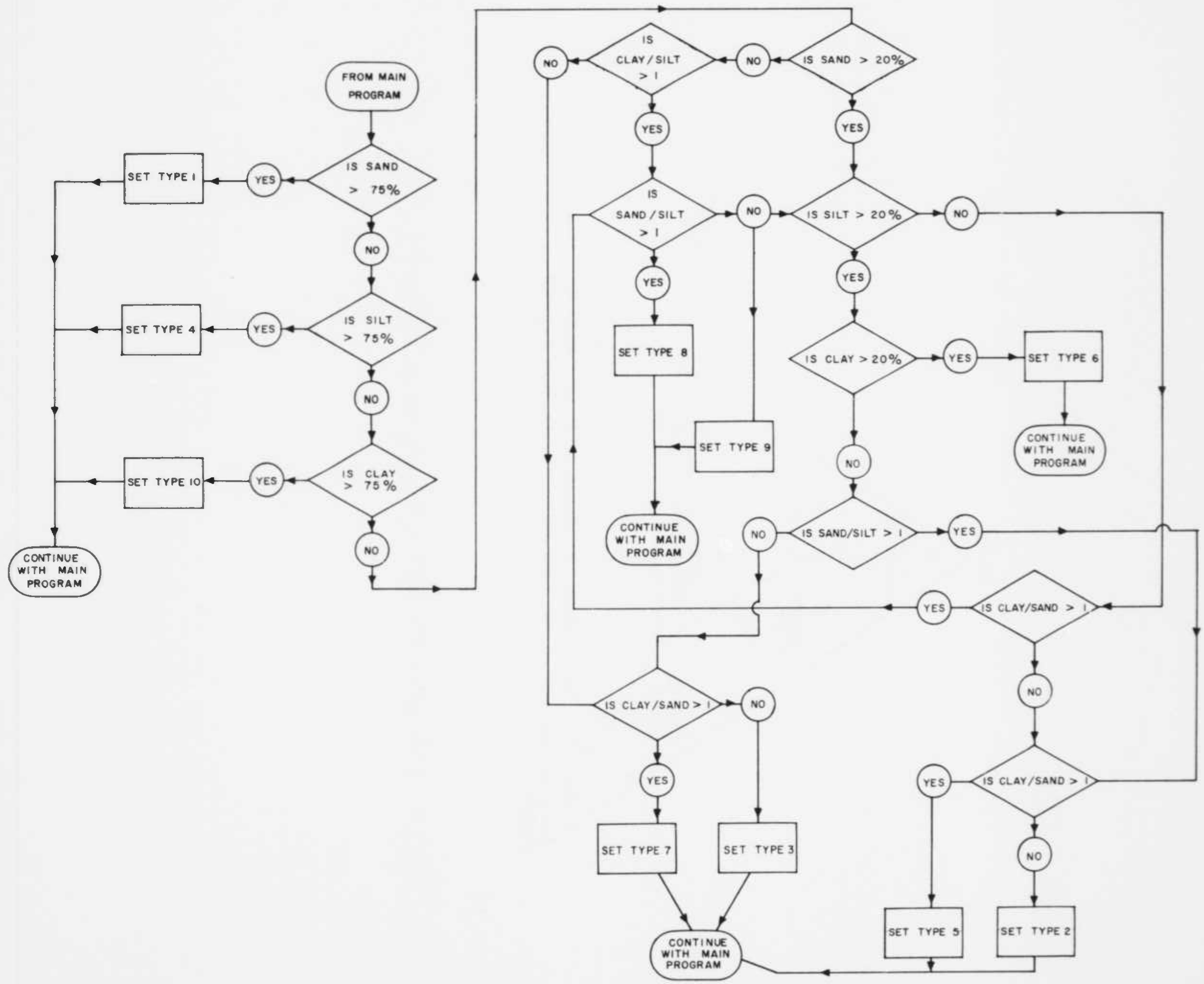


Fig. 7 Flow Chart for Determining Position of Sample on the Shepard Diagram

## 3.8 Trask Values

The Trask values (Krumbein and Pettijohn, 1938) computed are first, second and third quartiles ($Q_1$, $Q_2$ and $Q_3$) expressed in millimeters, the geometric quartile deviation ($S_o$), the log quartile deviation (Log SO) and the quartile skewness (SKG). The equations for these values are

$$Q_1 = e^{-\phi_{25} \log_e 2} \tag{3.9}$$

$$Q_2 = e^{-\phi_{50} \log_e 2} \tag{3.10}$$

$$Q_3 = e^{-\phi_{75} \log_e 2} \tag{3.11}$$

$$S_o = \sqrt{\frac{Q_1}{Q_3}} \tag{3.12}$$

$$SKG = \sqrt{\frac{Q_1 \cdot Q_3}{Q_2^2}} \tag{3.13}$$

$$\text{Log SO} = \log_{10} S_o \tag{3.14}$$

where $\phi_{25}$, $\phi_{50}$ and $\phi_{75}$ are the phi-sizes at the 25, 50 and 75 percentile levels. An output statement is prepared at the completion of these calculations.

## 3.9 Inman Values

The Inman statistics (Inman, 1952) computed are the median (Md $\phi$), mean (M $\phi$), deviation or sorting ($\sigma\phi$), and skewness ($\alpha\phi$). If the next-to-last accumulated percentage is greater than 92, the second skewness ($\alpha 2\phi$) and kurtosis ($\beta\phi$) are also computed. The equations are the following:

$$\text{Md } \phi = \phi_{50} \tag{3.15}$$

$$\text{Md } \phi = 1/2 \cdot (\phi_{16} + \phi_{84}) \tag{3.16}$$

$$\sigma\phi = 1/2 \cdot (\phi_{84} - \phi_{16}) \tag{3.17}$$

$$\alpha\phi = \frac{\text{M } \phi - \text{Md } \phi}{\sigma\phi} \tag{3.18}$$

$$\alpha_{2\phi} = \frac{\left[1/2 \cdot (\phi_5 + \phi_{95})\right] - Md\,\phi}{\sigma_\phi} \qquad (3.19)$$

$$\beta_\phi = \frac{\left[1/2 \cdot (\phi_{95} - \phi_5)\right] - \phi}{\sigma\,\phi} \qquad (3.20)$$

when $\phi_5$, $\phi_{16}$, $\phi_{50}$, $\phi_{84}$ and $\phi_{95}$ are the phi-values at percentile levels of 5, 16, 50, 84, and 95. If the second skewness ($\alpha_{2\phi}$) and kurtosis ($\beta\,\phi$) cannot be calculated the IBM 650 program substitutes 99.99 for these values and the IBM 709 omits these calculations and states this fact with a comment.

### 3.10 Folk and Ward Values

The Folk and Ward statistics (Folk and Ward, 1957) computed are the mean (Mz), the inclusive graphic standard deviation ($\sigma_1$), skewness (Sk) and kurtosis (Kg) from the equations

$$Mz = (\phi_{16} + \phi_{50} + \phi_{84}) \div 3 \qquad (3.21)$$

$$\sigma_1 = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6} \qquad (3.22)$$

$$SK = \frac{\phi_{16} + \phi_{84} + 2\phi_{50}}{2(\phi_{84} - \phi_{16})} + \frac{\phi_5 + \phi_{95} - 2\phi_{50}}{2(\phi_{95} - \phi_5)} \qquad (3.23)$$

$$Kg = \frac{\phi_{95} - \phi_5}{2.44\,(\phi_{75} - \phi_{25})} \qquad (3.24)$$

After each of these values, except the mean, is computed, the result is given a type number as stated in Tables 12, 13 and 14. An output statement of these results is prepared before the program goes to the initializing block.

### 3.11 Initializing

Before each sample is read, the words in memory used for the storage of phi size, fraction percentage and accumulated percentages are set to 999.99. Also, many locations are set back to their original condition because of address modification during the computations. After initializing, the program reads the data contained in the first card of the next sample and the process is repeated beginning with section 3.5.

TABLE 12

FOLK AND WARD CODE FOR STANDARD DEVIATION

| Code | Range of Standard Deviations From | To | Verbal Scale |
|---|---|---|---|
| 1 | 0.00 | 0.34 | very well sorted |
| 2 | 0.35 | 0.50 | well sorted |
| 3 | 0.51 | 1.00 | moderately sorted |
| 4 | 1.01 | 2.00 | poorly sorted |
| 5 | 2.01 | 4.00 | very poorly sorted |
| 6 | over 4.00 | | extremely poorly sorted |

TABLE 13

FOLK AND WARD CODE FOR SKEWNESS

| Code | Range of Skewness From | To | Verbal Scale |
|---|---|---|---|
| 1 | -1.00 | -0.30 | very negative-skewed |
| 2 | -0.30 | -0.10 | negative-skewed |
| 3 | -0.10 | 0.10 | nearly symmetrical |
| 4 | 0.10 | 0.30 | positive-skewed |
| 5 | 0.30 | 1.00 | very positive-skewed |

TABLE 14

FOLK AND WARD CODE FOR KURTOSIS

| Code | Range of Kurtosis From | To | Verbal Scale |
|---|---|---|---|
| 1 | 0.65 | 0.90 | platykurtic |
| 2 | 0.91 | 1.11 | nesokurtic |
| 3 | 1.12 | 1.50 | leptokurtic |
| 4 | 1.51 | 3.00 | very leptokurtic |
| 5 | over 3.00 | | extremely leptokurtic |

### 3.12 Differences between the 650 and 709 programs

The major difference between the 650 and 709 sediment description programs is the method of output. The 650 produces cards only while the 709 produces a written output. Other differences in the programs are in the method of writing the output statements. The 709 writes more comments, explaining if data are missing or what computations could not be made for insufficient values. Also, in case of errors detected in the sample, the 709 program writes an error statement indicating the nature of the error and its location and then bypasses any further calculation on that sample.

### 3.13 Time required to process samples

If the 650 is used to process the samples, the computer time required to process a typical sample containing 17 size classes is 26 seconds. In addition, one and one-half minutes are required to load the program into storage. After the output is obtained, about three minutes per sample are required on the peripheral equipment to prepare the output. Thus, a good average time per sample, is about five minutes from the time the computations are begun until the finished output is obtained.

The time required to process the same sample on the 709 computer is approximately 4.5 seconds, including the preparation of the output tape. The printing time on the peripheral equipment is the same as for the 650 output, unless a faster printing device such as an IBM 1401, is available; in which case the printing time can be reduced to 1.5 second per sample with the page setting.

## 4. MOMENT MEASURE PROGRAM (No. 0214)

### 4.1 General Description

Another method of describing the particle size distribution of sediments is the method of moment measures which is described in detail in standard statistical textbooks (Mood, 1950; Herdan, 1960; Miller and Kahn, 1962). The equations defining the first moment about the origin (the mean), the second moment about the mean (the variance), the third moment about the mean (the skewness), and the fourth moment about the mean (the kurtosis) can be written in several forms, depending upon, for example, whether the distribution is by number or by weight of particles. For the weight distribution obtained in sediment studies, the moments may be defined as:

Mean: $$\bar{X} = \frac{1}{100} \sum fxi \qquad (4.1)$$

Standard Deviation: $$\sigma = \sqrt{\sum f \ (X_i - \bar{X})^2 / 100} \qquad (4.2)$$

Skewness: $\alpha_3 = \frac{1}{100}\sigma^{-3} \sum f \ (X_i - \bar{X})^3$ (4.3)

Kurtosis: $\alpha_4 = \frac{1}{100}\sigma^{-4} \sum f \ (X_i - \bar{X})^4$ (4.4)

where $X_i$ is the midpoint value of the size class and f is the fraction percentage for that class.

## 4.2 Computer Coding

The Moment Measure Program was coded in FORTRAN and it is listed in Appendix 5. The conversion subroutine BTSNU (see Appendix 6) must be included after the FORTRAN program.

## 4.3 Computation Performed by the Program (see flow chart, Figure 8)

Although the four moments are defined by the equation in section 4.1, the computation of the moments is based on a short method using the variable "u". This variable is a linear transformation of the midpoints, $X_i$ of the classes, and is obtained by the following equation:

$$u = \frac{(X_i - X_o)}{\omega} \qquad (4.5)$$

where $X_o$ is a class mark chosen near the mean of the distribution, and $\omega$ is the class interval.

Using the variable "u" instead of $X_i$, we can now compute the moments of the distribution around the point $X_o$. These moments, $V_i$, are defined as:

$$V_i = \frac{\sum u_i f}{\sum f}, \quad (i = 1,2,3,4), \qquad (4.6)$$

where $V_i$ is the $i^{th}$ moment about $X_o$, and f is the percentage frequency in each class.

From these moments of the distribution about $X_o$, it is possible to compute the first moment about the origin of the distribution and the second, third, and fourth moments about the mean. However, since no measure of the class interval, , is included, these moments are called "data moments", $M_i$, and are defined as follows:

First Data Moment: $m_1 = v_1 + x_o$ (4.7)

Second Data Moment: $m_2 = v_2 - v_1^2$ (4.8)

Third Data Moment: $m_3 = v_3 - 3v_1v_2 + 2v_1^3$ (4.9)

Fourth Data Moment: $m_4 = v_4 - 4v_1v_3 + 6v_1^2v_2 - 3v_1^4$ (4.10)

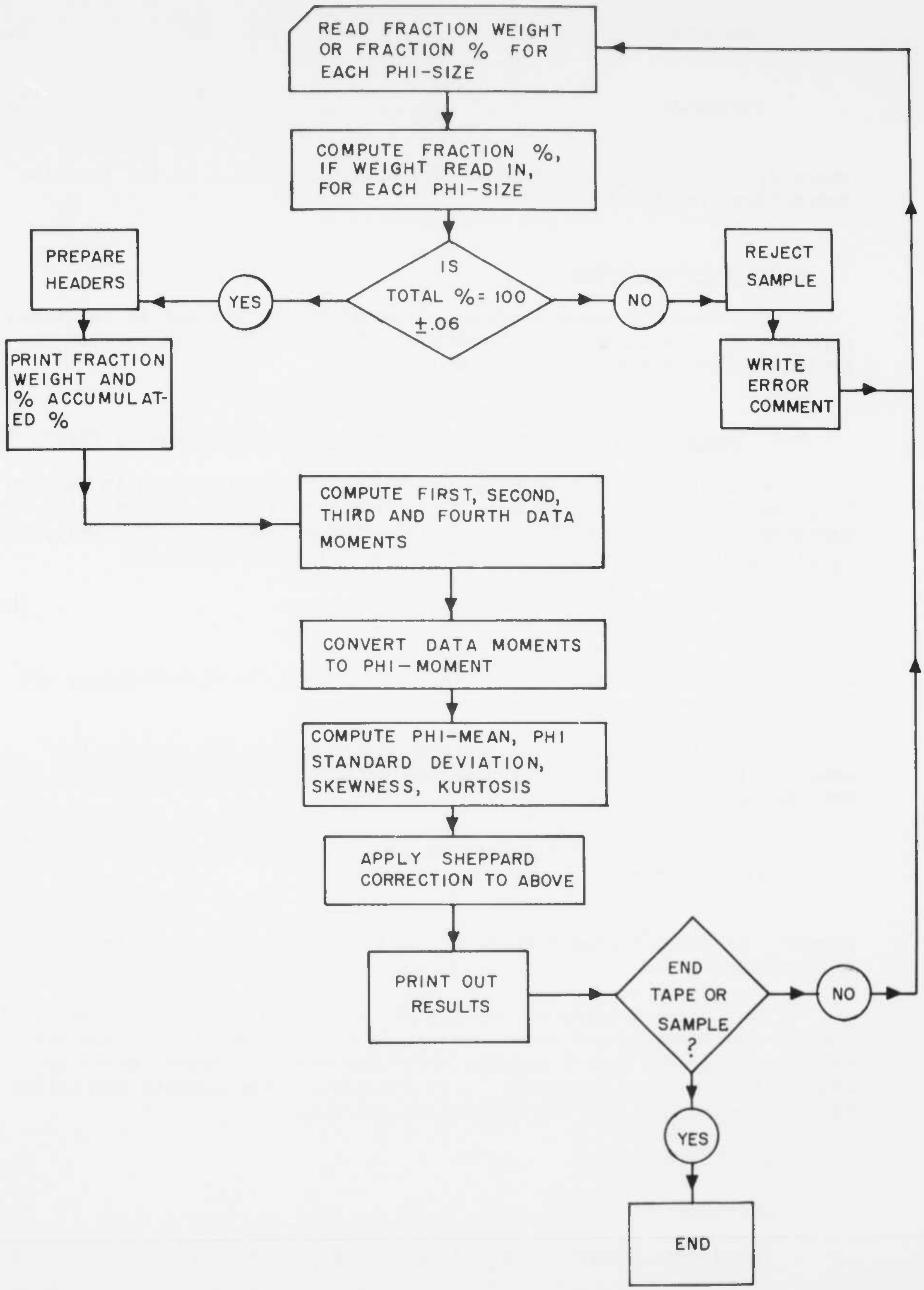


Fig. 8 Flow Chart for Moment Measure Program

These moments must now be changed to Phi Moments, $P_i$, in order to describe the distribution in values of phi notation as follows:

$$P_i = \omega^i m_i \quad (i = 1,2,3,4) \tag{4.11}$$

where $P_i$ is the $i^{th}$ Phi Moment, $m_i$ is the $i^{th}$ Data Moment, and $\omega$ is the class interval in phi-units (1/4, 1/2, 1, . . .)

The first four Phi Moments are defined as:

Phi Mean (First Phi Moment): $\bar{X}_\phi = P_i$ (4.12)

Phi Standard Deviation: $S_\phi = \sqrt{P_2}$ (4.13)

Phi Skewness: $\alpha_3 = p_3 / (p_2)^{3/2}$ (4.14)
(Third Phi Moment)
(Third Alpha Moment)

Phi Kurtosis: $\alpha_4 = p_4 / (p_2)^2$ (4.15)
(Fourth Phi Moment)
(Fourth Alpha Moment)

Because the data are grouped into classes, a correction called Shepard's Correction must be applied to second and high Data Moments. The effect of the class width on the mean, $\bar{X}$, is usually negligible (Topping, 1955, p. 43). The corrections which are applied to the Data Moments are:

Shepard Correction for Second Data Moment:

$$M_2' = M_2 - \frac{1}{12}\omega_i^2 \tag{4.16}$$

Shepard Correction for Fourth Data Moment:

$$M_4' = M_4 - \frac{1}{2}\omega_i^2 M_2 + \frac{7}{240}\omega_i^4 \tag{4.17}$$

where $M_2'$ is the corrected Second Data Moment, and $M_4'$ is the corrected Fourth Data Moment.

The Corrected Data Moments are now converted to Corrected Phi Moments by the equation:

$$P_i' = \omega_i m_i' \tag{4.18}$$

where $P_i$ is the corrected $i^{th}$ Phi Moment.

The Corrected Phi Moments are then expressed as:

Corrected Phi Standard Deviation: $S_\phi' = \sqrt{P_2'}$ (4.19)

Corrected Phi Skewness: $\alpha_3' = P_3 / (P_2')^{3/2}$ (4.20)

Corrected Phi Kurtosis: $\alpha_4' = P_4' / (P_2')^2$ (4.21)

## 4.4 Input Data and Output

The detail cards described in section 2.2.2 are the input to this program. Error checks and conversion of the input data are identical to the program block described in detail in sections 3.3 and 3.4 of the Sediment Description Program. A count of the cards is made by the program and stored for the purpose of obtaining mean values of the size classes.

The output of the results is in written form as shown in Figure 9. No card output is planned but may be added by appropriate addition to the FORTRAN program.

## 4.5 Timing

The computer time required to process a typical sample of 17 size classes is 4 seconds, including preparation of the output tape. Printing time on the 1401 is 6 seconds per sample.

# 5. CONCLUSION

Two basic types of programs for electronic data processing of data from particle size analysis of sediments have been described in this report. The purpose of these programs is to alleviate the tedium of the computations for the geologist and to increase precision by minimizing the chances for operator error. The compatibility of the output values with hand calculations was demonstrated by Creager, McManus, and Collias (1962).

With regard to selection of the appropriate basic program type (sediment description or moment measure) for data processing of analyses, no set rule can be given. The choice is that of the investigator. If the graphic measures from the sediment description programs are considered to be approximations of the moment measures, then the moment measures may be preferred. If, on the other hand, as Friedman (1962, p. 742) notes, both measures are considered simply as descriptive measures, then they are equally valid.

Usually, the graphic measures are considered to be approximations of the moment measures, and as such are referred to as Inefficient Statistics (Dixon and Massey, 1957, p. 264-267). It was in the sense of approximations to the moment measures that Inman (1952) and Folk and Ward (1957) proposed their percentile estimates, although the numbers obtained in these estimates are, of course, not directly comparable with the numbers of the moment measures.

CRUISE BB 236 STATION 010 EXID 02

SAMPLER TYPE SG DATE 08/03/59 LAT. 67-21.0N LONG. 166-47.0W
DEPTH FROM TOP OF CORE 00310 MM LENGTH OF CORE 01750 MM

| PHI SIZE | FRACTION PERCENT | ACCUMULATED PERCENT |
|---|---|---|
| -2.00 | 0.00 | 0.00 |
| -1.00 | 0.16 | 0.16 |
| 0.00 | 0.03 | 0.19 |
| 1.00 | 0.07 | 0.26 |
| 2.00 | 0.17 | 0.43 |
| 3.00 | 0.90 | 1.33 |
| 4.00 | 10.93 | 12.26 |
| 5.00 | 48.46 | 60.72 |
| 6.00 | 15.77 | 76.49 |
| 7.00 | 8.63 | 85.12 |
| 8.00 | 4.76 | 89.88 |
| 9.00 | 2.98 | 92.86 |
| 10.00 | 2.68 | 95.54 |
| 11.00 | 1.19 | 96.73 |
| 12.00 | 3.27 | 100.00 |

FIRST DATA MOMENT = 5.173

SECOND DATA MOMENT = 2.382

THIRD DATA MOMENT = 4.499

FOURTH DATA MOMENT = 30.843

CONVERSION OF DATA MOMENTS TO PHI MOMENTS.

5.173 2.382 4.499 30.843

PHI STANDARD DEVIATION = 1.543

PHI MEAN = 5.173

SKEWNESS (THIRD ALPHA MOMENT) = 1.224

KURTOSIS (FOURTH ALPHA MOMENT) = 5.435

SHEPPARD CORRECTION FOR SECOND DATA MOMENT = 2.299

SHEPPARD CORRECTION FOR FOURTH DATA MOMENT = 29.681

CONVERSION OF CORRECTED DATA MOMENTS TO CORRECTED PHI MOMENTS.

2.299 29.681

CORRECTED PHI STANDARD DEVIATION = 1.516

CORRECTED SKEWNESS = 1.291

CORRECTED KURTOSIS = 5.617

Fig. 9 Example of Output from Moment Measure Program

The efficiency of the percentile estimates of the moment measures, at least for the mean and standard deviation, may be found in the works of Yost (1948), Dixon and Massey (1957, p. 404-405), and McCammon (1962b). An empirical comparison of the percentile estimates of standard deviation as an indicator of sorting of sediment particles is reported by Friedman (1962). An examination of these relationships, and the consideration of the graphic measures as approximations of the percentile estimates would suggest that the moment program provides data for a more meaningful interpretation of the sediment history and environment. Yet, there are three qualifying statements that must be considered:

1) moment measures are valid only if the sediment particle sizes are lognormally distributed, but as has been shown by Tanner (1958), Fuller (1961), and others, the sizes of sediment particles are not always lognormally distributed;

2) as noted by McCammon (1962a), the first four moments of a size frequency distribution do not necessarily characterize its shape; and

3) until a more fundamental significance of sediment size analyses is determined than merely the identification of geographic groupings of sedimentary environments, no final decision among moment measures, graphic measures, or other measures is possible.

## 6. ACKNOWLEDGMENT

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APPENDIX 1

## Wiring of control panel for the type 533 Read-Punch unit

Rather than show a wiring diagram, the wiring for the type 533 read-punch unit will be described. The wiring is straight forward except in one case involving the punch code selectors which require the use of filters not included in the 533 unit.

| | |
|---|---|
| Cols 1-5 First reading to Alphabetic first read W1 | A23-27 to AK13-17 |
| Cols 6-10 First reading to Alphabetic first read W2 | A28-32 to AK18-22 |
| Col 45 First reading to pilot selector X PU-2 | C27 to E24 |
| Col 55 First reading to pilot selector X PU-3 | C37 to E25 |
| Col 65 First reading to pilot selector X PU-4 | D27 to E26 |
| Col 75 First reading to pilot selector X PU-5 | D37 to E27 |
| Col 80 First reading split wired to LOAD and pilot selector X PU-1 | D42 to E23 and B22 |
| Pilot selectors 1-5 transfer to Read impulse 9 | H23-27 to V33 |
| Pilot selectors 1-5 normal to Read impulse 8 | J23-27 to V34 |
| Pilot selectors 1-5 common to Storage entry C word 10 | K23-27 to AJ17-21 |
| Pilot selector hold 1-5 to Read hold | P23-27 to T39 |
| Read card C 1-5 to Storage entry C word 1 (1-5) (see note 1) | X1 - 5 to AE6 -10 |
| Read card C 6-10 to Storage entry C word 2 (1-5) (see note 1) | X6 -10 to AE17-21 |
| Read card C 11-20 to Storage entry C word 3 | X11-20 to AF1 -10 |
| Read card C 21-30 to Storage entry C word 4 | X1 -10 to AF12-21 |
| Read card C 31-40 to Storage entry C word 5 | Y11-20 to AG1 -10 |
| Read card C 41-50 to Storage entry C word 6 | Z1 -10 to AG12-21 |
| Read card C 51-60 to Storage entry C word 7 | Z11-20 to AH1 -10 |
| Read card C 61-70 to Storage entry C word 8 | AA1-10 to AH12-21 |
| Read card C 71-80 to Storage entry C word 9 | AA11-20 to AJ1-10 |
| Read sign over units is jackplugged | V24 to W24 |
| Word size emitter 10 to word size entry C W1, W2, W3, W4, W5, W6, W7, W8 and W9 | AK11 to AQ1 - 9 |
| Word size emitter 5 to word size entry C W10 | AK6 to AQ10 |
| Constant Alphabetic Impulse (CAI) to Alphabetic in W1 and W2 | AK12 to AL11-12 |
| Punch sign over units (PSU) exit split wired to PSU entry and Alphabetic out W1 and W2 | W41 to V41 and AK53 and AL53 |
| Storage Exit C word 1 (1-5) to Punch card C 1-5 | AE48-52 to X45-49 |
| Storage Exit C word 2 (1-5) to Punch card C 6-10 | AE59-63 to X50-54 |
| Storage Exit C word 3 to Punch Card C 11-20 | AF43-52 to X55-64 |
| Storage Exit C word 4 to Punch Card C 21-30 | AF54-63 to Y45-54 |
| Storage Exit C word 5 to Punch Card C 31-40 | AG43-52 to Y55-64 |
| Storage Exit C word 6 to Punch card C 41-50 | AG54-63 to Z45-54 |
| Storage Exit C word 7 to Punch card C 51-60 | AH43-52 to Z55-64 |
| Storage Exit C word 8 to Punch card C 61-70 | AH54-63 to AA45-54 |
| Storage Exit C word 9 to Punch card C 71-80 | AJ43-52 to AA55-64 |

Note 1 - Storage entry C words 1 and 2 are wired for alphameric information

| | | |
|---|---|---|
| Control information 2-5 to Punch code selectors I PU 2-5 | AM60-63 | to AN60-63 |
| X-impulse to Punch code selectors common 2-5 | AR54 | to AR60-63 |
| Punch code selector transfer 5 to filter (see note 2) to Punch card C 45 by split wire | AP60 | to Z 49 |
| Punch code selector transfer 4 to filter to punch card C 55 by split wire | AP61 | to Z 59 |
| Punch code selector transfer 3 to filter to punch card C 65 by split wire | AP62 | to AA49 |
| Punch code selector transfer 2 to filter to punch card C 75 by split wire | AP63 | to AA59 |

Note 2 - If commercial filters are not available, a 1N538 silicon rectifier may be used with the base connection going to the Punch card C entry.

APPENDIX 2

## Wiring of control panel for the IBM 407 tabulator

### A) TRANSFER PRINT

1) Second Read: 13-75 (G 13-40 and H 1-35) to
Tr. Pr.: 32-94 (S 32-40 and U 1-14)

2) Tr. Pr. Control: First Read Col. 80 (B 40) to Com. "A" Digit Sel. (A 41)
"9" of "A" Digit Sel. (M 42) to D.P.U. P. Sel. 15 (F 67).
Coupling Exit P. Sel. 15 (G 67) to Tr. Pr. P. U. (R 40).

Note: All header cards (9 punch col. 80) print in Tr. Pr. First Read

Note: First Read Hubs are used for machine control only.

D.P.U. of P. Sel. 15 (G 67) to I.P.U. P. Sel. 18 (H 70).
First Read Col. 30 to Com. Hub P. Sel. 18 (K 70).
Norm. Hub. P. Sel. 18 (J 70) to Com. Hub "B" Digit Sel. (A 44).

3) Digit Sel. "A" (Under First Read Control)
7 Hub (K 42) to I.P.U. P. Sel. 20 (H 72).
8 Hub (L 42) to D.P.U. P. Sel. 8 (G 60).

4) Digit Sel. "B" (Under First Read Control)
0 (Zero) Hub (D 43) to 1 (One) Hub (E 43).
1 (One) Hub (E 44) to D.P.U. P. Sel. 1 (One) (G 53).
2 Hub (F 44) to D.P.U. P. Sel. 2 (F 54).
3 Hub (G 44) to D.P.U. P. Sel. 3 (G 55).
D.P.U. P. Sel. 3 (F 55) to I.P.U. P. Sel. 16 (H 66).
4 Hub (H 44) to D.P.U. P. Sel. 4 (F 56).
5 Hub (I 44) to D.P.U. P. Sel. 5 (G 57).
6 Hub (J 44) to D.P.U. P. Sel. 6 (G 58).
7 Hub (K 44) to D.P.U. P. Sel. 7 (G 59).

Note: The above impulses are control punches punched in Col. 30 of "Detail" Cards.

Col. 30 is wired from First Read through Com. and Norm. of P. Sel. 18 to the Com. Hubs of digit selector B.

Continuation of First Read Control Punches.
40 Hub (A 40) to Transfer Hub Co-Sel. 14 (Z 51).
Com. Hub Co-Sel. 14 (AB 51) to Com. P. Sel. 14 (N 66).
Tr. P. Sel. 14 (L 66) to Norm. P. Sel. 11 (M 63).
Com. P. Sel. 11 (N 63) to D.P.U. P. Sel. 13 (G 65).
First Read Hub 77 (B 37) to Com. Co-Sel. 14 (AB 50).

Tr. Co-Sel. 14 (Z 50) to I.P.U. P. Sel. 17 (H 69).
First Read Hub 78 (B 38) to X.P.U. P. Sel. 20 (D 72).
First Read Hub 79 (B 39) to X Carriage Skip One (I 31).
Co-Sel. Pick-Up
Coupling Exit Impulses From P. Sel.
Coupling Exit P. Sel. 1 (C 53) to Co-Sel. P.U. 9 and 10 (A 61) and (B 62 to A 62).

2 (C 54) to Co-Sel. P.U. 15, 16, 17, 18, and 19. (A 67): B 68 to A 68, B 69 to A 69, B 70 to A 70, B 71 to A 71).

3 (C 55) to Com. P. Sel. 11 (K 63). Norm. P. Sel. 11 (J 63) to Co-Sel. P.U. 8 (A 60).

4 (C 56) to Co-Sel. P.U. 4 (B 57) and Co-Sel. P.U. 1 and 2 (A 56 to A 53, B 54 to A 54).

5 (C 57) to Co-Sel. P.U. 5 (A 57).

6 (C 58) to Co-Sel. P.U. 6 (A 58).

7 (C 59) to Co-Sel. P.U. 20, 21, 22, Alter Switch 2 Com. and Tr., and Co-Sel. P.U. 28. (A 72, B 73 to A 73, B 74 to A 74, B 75 to G 74, E 74 to A 80).

13 (C 65) to Co-Sel. P.U. 7 and D.P.U. P. Sel. 12. (A 59, B 60 to F 64).

15 (R 39) to Co-Sel. P.U. 27 (A 79).

Major First Card (ø 73) to Co-Sel. P.U. 3 and 29. (B 56, A 55 to C 73).
Prog. Cpl. 4 (AS 69) to Filter Entry 10 (BK 24)
Filter Exit 10 (BL 24) to Prog. Cpl. 3 (AR 69).
Prog. Cpl. 3 (AR 70) to Co-Sel. P.U. 29 (D 74).
Card Cycles (ø 71) to Com. P. Sel. 19 (N 71).
Tr. P. Sel. 19 (L 71) to Co-Sel. P.U. 11, 12, and 13. (A 63, B 64 to A 64, B 65 to A 65).

B) DETAIL CARD WIRING

From Second Read

36-39 (AC 36-39) to Tr. Co-Sel. 15 (Aø 2-5)
Com. Co-Sel. 15 to Norm. Co-Sel. 10 (X 49-52).
Com. Co-Sel. 10 to N.P.E. 51-55 (W 11-15).
42-45 (AE 2-5) to Tr. Co-Sel. 16 (Aø 7-10).
Com. Co-Sel. 16 (AQ 7-10) to N.P.E. 60 - 64 (W 60 -64).
46-50 (AE 6-10) to Tr. Co-Sel. 17 (Aø 11-15).
Com. Co-Sel. 17 (AQ 11-15) to N.P.E. 68-73 (W 28-33).

42-45 (AE 2-5) to Prog. Sel. L. 1 (I 1-4).
Com. Prog. Sel. (N 1-4) to N.P.E. 33-37 (V 33-37).
47-50 (AE 7-10) to Prog. Sel. L. 1 (I 6-9)
Com. Prog. Sel. (N 6-9) to Norm. Co-Sel. 28 (BA 56-60).
Com. Co-Sel. 28 (BB 56-60) to N.P.E. 42-46 (W 2-6).
52-55 (AE 12-15) to Prog. Sel. L. 1 (I 11-14)
Com. Prog. Sel. (N 11-14) to Norm. Co-Sel. 15 (AP 2-5).
57-60 (AE 17-20) to Prog. Sel. L. 1 (I 16-19).
Com. Prog. Sel. L. 1 (N 16-19) to Norm. Co-Sel. 20 (AP 27-30).
Com. Co-Sel. 20 (AQ 27-30) to Norm. Co-Sel. 16 (AP 7-10).
62-65 (AE 22-25) to Prog. Sel. L. 1 (I 21-24).
Com. Prog. Sel. L. 1 (N 21-24) to Norm. Co-Sel. 17 (AP 12-15).
67-70 (AE 27-30) to Norm. Co-Sel. 18 (AP 17-20).
Com. Co-Sel. 18 (AQ 17-20) to Norm. Co-Sel. 21 (AP 32-35).
Com. Co-Sel. 21 (AQ 32-35) to N.P.E. 78-82 (W 38-40, X 1-2).
72-75 (AE 32-35) to Norm. Co-Sel. 19 (AP 22-25).
Com. Co-Sel. 19 (AQ 22-25) to Norm. Co-Sel. 6 (Q 67-70).
Com. Co-Sel. 6 (R 67-70) to Norm. Co-Sel. 5 (Q 62-65).
Com. Co-Sel. 5 (R 62-65) to N.P.E. 86-90 (X 6-10).
41-45 (AF 1-5) to Prog. Sel. L. 2 (J 1-5).
Com. Prog. Sel. (N 1-5) to N.P.E. 33-38 (V 33-38).
46-50 (AF 6-10) to Prog. Sel. L. 2 (J 6-10).
Com. Prog. Sel. (N 6-9) to Norm. Co-Sel. 28 (BA 56-60).
Com. Prog. Sel. (N 10) to N.P.E. 47 (W 7).
51-55 (AF 11-15) to Prog. Sel. L. 2 (J 11-15)
Com. Prog. Sel. (N 11-14) to Norm. Co-Sel. 15 (AP 2-5).
Com. Prog. Sel. (N 15) to N.P.E. 56 (W 16).
56-60 (AF 16-20) to Prog. Sel. L. 2 (J 16-20).
Com. Prog. Sel. (N 16-19) to Norm Co-Sel. 20 (AP 27-30).
Com. Prog. Sel. (N 20) to N.P.E. 65 (W 25).
61-65 (AF 21-25) to Prog. Sel. L. 2 (J 21-25).
Com. Prog. Sel. (N 21-24) to Norm. Co-Sel. 17 (AP 12-15)
Com. Prog. Sel. (N 25) to N.P.E. 74 (W 34).

## C) WIRING FOR PROOF READ INPUT CARDS

From Second Read
1- 5 (AC 1-5) to Com. Co-Sel. 11 (AB 33-37).
Tr. Co-Sel. 11 (Z 33-37) to N.P.E. 1-5 (V 1-5).
6- 8 (AC 6-8) to Com. Co-Sel. 12 (AB 38-40).
Tr. Co-Sel. 12 (Z 38-40) to N.P.E. 7-9 (V 7-9).
11-12 (AC 11-12) to Com. Co-Sel. 12 (AB 41-42).
Tr. Co-Sel. 12 (Z 41-42) to N.P.E. 11-12 (V 11-12)
31-35 (AC 31-35) to Com. Co-Sel. 13 (AB 43-47)
Tr. Co-Sel. 13 (Z 43-47) to N.P.E. 15-19 (V 15-19).

## D) PILOT AND CO-SELECTOR PICK-UP

Split Column Control Half After 11 Time (J 77) to Co-Sel. P.U. 23, 24, 25, and 26. (A 75, B 76 to A 76, B 77 to A 77, B 78 to A 78).
Card Cycles (ø 53) to Com. P. Sel. 1 (K 53); Tr. P. Sel. 1 (I 53) to D.P.U. P. Sel. 19 (F 71).
Card Cycles (ø 54) to Com. P. Sel. 1 (N 53); Tr. P. Sel. 1 (L 53) to Counter Entry 3A (S 55).
Counter Entry 3A (T 55) to Counter 8C (T 64).

Card Cycles (ø 63) to Com. P. Sel. 2 (N 54); Norm. P. Sel. 2 (M 54) to
Com. Co-Sel. 9 (Y 47);
Norm. Co-Sel. 9 (X 47) to Com. P. Sel. 5 (K 57);
Norm. P. Sel. 5 (J 57) to Progressive Sel. Cpl. 1 (I 30).
Tr. P. Sel. 5 (I 57) to Progressive Sel. Cpl. 2 (J 30).
Second Read Hub 60 (AE 20) to Com. Col. Split (AF 48);
(11-12) Col. Split (AD 48) to Com. P. Sel. 2 (K 54).
Norm. P. Sel. 2 (J 54) to Norm. Pr. Entry 59 (W 19).
Card Cycles (ø 55) to Com. P. Sel. 3 (N 55); Tr. P. Sel. 3 (L 55) to
Bus (N 50).
Card Cycles (ø 61) to Com. P. Sel. 3 (K 55); Tr. P. Sel. 3 (I 55) to
Extra Space (K 76).
Card Cycles (ø 56, 57, 58) to Com. P. Sel. 4, 5, 6 (N 56, 57, 58).
Tr. P. Sel. 4, 5, 6 (L 56, 57, 58) to Bus Hubs (N 51, 52 and ø 50)
Zero Pr. Control (BL 47) to Com. P. Sel. 4 (K 56)
Norm. P. Sel. 5 (J 56) to Com. Co-Sel. 23 (AY 45)
Norm. Co-Sel. 23 (AX 45) to Bus Hubs (BK 7)
CO - CC (ø 79) to Com. P. Sel. 7 (K 59); Tr. P. Sel. 7 (I 59) to Co-Sel.
P.U. 28 (D 73).
Card Cycles (ø 59) to Com. P. Sel. 7 (N 59); Tr. P. Sel. 7 (L 59) to
Bus Hubs (ø 51).
Card Cycles (ø 60) Com. P. Sel. 8 (N 60); Tr. P. Sel. 8 (L 60) to Ma.
Prog. Start (E 32).
Emitter (*, V 41) to Tr. P. Sel. 10 (I 62); * Symbol Exit 3A (AG 55) to
Norm. P. Sel. 10 (J 62).
Com. P. Sel. 10 (K 62) to Norm. Co-Sel. 29 (BA 62).
Com. Co-Sel. 29 (BB 62) to Norm. Pr. Entry 75 (W 35).
Col. Split Cpl. (AC 52) to Co-Sel. P.U. 14 (A 66).
Second Read Hub 40 (AD 40) to Col. Split (AF 41).
Col. Split (AE 41) to Com. P. Sel. 13 (K 65).
Tr. P. Sel. 13 (I 65) to Norm. Pr. Entry Hub 93 (X 13).
Zero Pr. Control 76 (BJ 76) to Com. P. Sel. 15 (N 67).
Tr. P. Sel. 15 (L 67) to Norm. Co-Sel. 24 (AX 48).
Com. Co-Sel. 24 (AY 48) To Entry 0 (BI 36).
Card Cycles (ø 69 and 71) to Com. P. Sel. 17 and 20 (N 69 and 71).
Tr. P. Sel. 17 and 20 (L 69 and 71) split wired and taken into
"Extra Space" (K 76).
P. Sel. Tr. Hub 3 (I 55) split wired with Bus Hub (ø 52) and taken into
"Extra Space" (K 77).
Alter Switches
Alter Switch Ex. (H 73) to Com. Alter Sw. 1 (G 73).
Tr. Alter Sw. 1 (E 73) to D.P.U. P. Sel. 19 (F 71).
Alter Switch Exit 3 (H 75) to Com. Alter Sw. 3 (G 75);
Tr. Alter Switch 3 (E 75) to I.P.U. P. Sel. 11 (H 63).
"Ro" (G 79) to Com. Alter Sw. 4 (G 76).
Tr. Alter Sw. 4 (E 76) to "On" (H 79).

## E) COUNTER CONTROLS

3A Neg. Bal. Off (AF 55) to 3A Neg. Bal.Control (AE 55).
8C Neg. Bal. Off (AF 64) to 8C Neg. Bal. Control (AE 64).
* Symbol Exit 8C (AG 64) to Norm. Co-Sel. 29 (BA 61).
Com. Co-Sel. 29 (BB 61) to Norm. Pr. Entry 76 (W 36).

Note: The * symbol from counter 8C is split wired with second read col. 70 into print wheel 76 of normal print entry. 8C is wired with second read col. 70 co.sel. 29 and col. 70 is wired through co-sel. 22 and then split wired into norm. pr. entry 76.

## F) COUNTER WIRING

Carry Exit 8C (AK 64) to Carry Entry 8C (AØ 64).
Program Step 2 Inter (AQ 64) to Read Out and Reset 8C (AØ 64).
Final Total (AP 73) to Read Out and Reset 8C (AN 64).
Int. First Card (N 74) and Major First Card (Ø 74) split wired and taken into Storage in "D" of Unit A.
Program Step 1, Minor, (AP 56) to Storage Out Immediate of Unit "A" (AL 47).
Stor. Out Immediate, Unit "A" (AK 47) to I.P.U. P. Sel. 10 (H 62).
Second Read Hubs 46-50 (AF 6-10) to Counter Entry 8C (AJ 17-21).
    Counter Exit 8C (AU 14-21) to Counter Controlled Pr. 66-74, (BA 26-34).
Second Read Hubs 51-55 (AE 11-15) and 59-60 (AE 19-20) to
    Storage Entry Unit "A" (Ø 12-16) and (Ø 10-11).
    Storage Exit Unit "A" (Y 10-16) to Counter Exit 8C (AT 15-21).
Counter Entry 8C (AJ 17-21) to Progressive Sel. L. 2, Hubs 6-10 (J 6-10).

## G) WIRING AND PRINTING OF MINUS SIGNS

| Second Read Col. | to | Col. Splits Entry | to | Col. Split Exit (11-12) Impulses |
|---|---|---|---|---|
| 40 (AD 40) | | AF 41 | | (AD 41) to Co-Sel. 15 Tr. (AØ 1) |
| 40 (AC 40) | | AF 44 | | (AD 44) to Co-Sel. 10 Tr. (W 48) |
| 45 (AF 5) | | AF 45 | | (AD 45) to Co-Sel. 1 Norm. (Q 41) Co-Sel. 1 Com. (R 41) to Norm. Pr. 32 (V 32). |
| 50 (AF 10) | | AF 46 | | (AD 46) to Co-Sel. 1 Norm. (Q 42) Co-Sel. 1 Com. (R 42) to Norm. Pr. Entry 41 (W 1). |
| 55 (AF 15) | | AF 47 | | (AD 47) to Co-Sel. 1 Norm. (Q 43) Co-Sel. 1 Com. (R 43) to Co-Sel. 15 Norm. (AP 1). Co-Sel. 15 Com. (AQ 1) to Co-Sel. 10 Norm. (X 48). Co-Sel. 10 Com. (Y 48) to Norm. Pr. Entry 50 (W 10). |
| 60 (AE 20) | | AF 48 | | (AD 48) to Com. P. Sel. 2 (K 54). Norm. P. Sel. 2 (J 54) to Norm. Co-Sel. 1 (Q 44). Com. Co-Sel. 1 (R 44) to Norm. Pr. 59 (W 19). |

| Second Read Col. | to | Col. Splits Entry | to | Col. Split Exit (11-12) Impulses |
|---|---|---|---|---|
| 65 (AF 25) | | AF 49 | | (AD 49) to Norm. Co-Sel. 17 (AP 11). Com. Co-Sel. 17 (AQ 11) to Norm. Co-Sel. 4 (Q 56). Com. Co-Sel. 4 (R 56) to Norm. Co-Sel. 1 (Q 45). Com. Co-Sel. 1 (R 45) to Norm. Pr. Entry 68 (W 28). |
| 70 (AE 30) | | AF 50 | | (AD 50) to Norm. Co-Sel. 2 (Q 46). Com. Co-Sel. 2 (R 46) to Norm. Pr. Entry 77 (W 37). |
| 75 (AF 35) | | AF 51 | | (AD 51) to Norm. Co-Sel. 4 (Q 58). Com. Co-Sel. 4 (R 58) to Norm. Pr. Entry 85 (X 5). |

H) COLUMN SPLIT EXITS (0-9) IMPULSES

0-9 HUBS

AE 41 to Norm. Pr. Entry 93 (X 13)
AE 45 to Prog. Sel. L. 1, Hub 4 (I 4)
AE 46 to Prog. Sel. L. 1, Hub 9 (I 9)

I) COLUMN SPLITS 0-9 EXITS

AE 47 to Prog. Sel. L. 1, Hub 14 (I 14)
AE 48 to (Split Wired to Two Different Places):

1) Co-Sel. 22 Tr. (Aø 38)
   Co-Sel. 22 Com. (AQ 38) to Co-Sel. 20 Tr. (Aø 26)
   Com. Co-Sel. 20 (AQ 26) to N.P.E. 60 (W 20).

2) Prog. Sel. L. 1 Hub 19 (I 19)

AE 49 to Prog. Sel. L. 1, Hub 24 (I 24)
AE 50 to (Split Wired Into Two Different Places):

1) Com. Co-Sel. 22 (AQ 39)
   Tr. Co-Sel. 22 (Aø 39) is split wired into Norm. Pr. Entry 76 (W 36).

2) Norm. Co-Sel. 18 (AP 20)

AE 51 to Norm. Co-Sel. 19 (AP 25).

Second Read Col. 80 (AF 40) to Col. Split (AF 52)
(AE 52) to Com. Co-Sel. 22 (Aø 40)
Tr. Co-Sel. 22 (AQ 40) to N.P.E. 93 (X 13)

Bus Hub (BL 1) to Com. Col. Splits (AF 42)
(0-9) Col. Splits (AE 42) to Entry ϕ (BI 39).
(11-12) Col. Splits (AD 42) to (& -) BK 37.

Bus Hub (BK 1) to Com. Col. Splits (AF 43)
(0-9) Col. Splits (AE 43) to Entry ϕ (BI 40).

## J) DECIMAL POINT WIRING

Decimals are emitted from "Decimal" (AC 45-48) into Normal Print Entry.

N.P.E. Print Wheels

35 (V 35)

44 (W 44) This is wired through Co-Sel. 28 (BA 58 and BB 59) norm. and com.

53 (W 53)

62 (W 62)

71 (W 71)

80 (W 80)

88 (X 88)

## K) ZERO PRINT CONTROL WIRING

Z.P.C. Wiring for Forced Minus Signs and Zeroes:

Zeroes are wired from Z.P.C. to Bus Hubs (BK 1-14).
Zeroes and 11-12 zone punches are wired to Bus Hubs (BL 1-14).
A single wire is taken from (BK 1-14) to Com. of Col. Split.
"0-9" of Col. Split is wired to "Entry ϕ" Hubs.
A single wire is taken from (BL 1-14) to Com. of Col. Split.
"0-9" of Col. Split is wired to "Entry ϕ" Hubs.
"11-12" of Col. Split is wired to "&-" Hubs.
Forced zeroes and minus signs are wired through the Com. and Norm. Hubs of Co-Sel 23, 24, 25 and 26.

## L) ZERO PRINT CONTROL SELECTION

| ZERO PRINT CONTROL | to | SELECTION (Common Normal of Selectors) | to | BUS HUBS |
|---|---|---|---|---|
| 32 (BH 72) | | Co-Sel. 26 (BB 49, BA 49) | | BL 1-14 |
| 34 (BH 74) | | Co-Sel. 26 (BB 48, BA 48) | | BK 1-14 |

| ZERO PRINT CONTROL | to | SELECTION<br>(Common Normal of Selectors) | to | BUS HUBS |
|---|---|---|---|---|
| 41 (BJ 41) | | Co-Sel. 26 (BB 46, BA 46) | | BL 1-14 |
| 43 (BJ 43) | | Co-Sel. 26 (BB 47, BA 47) | | BK 1-14 |
| 50 (BJ 50) | | Co-Sel. 25 (BB 45, BA 45) | | BL 1-14 |
| 52 (BJ 52) | | Co-Sel. 25 (BB 44, BA 44) | | BK 1-14 |
| 59 (BJ 59) | | Co-Sel. 25 (BB 43, BA 53) | | BL 1-14 |
| 61 (BJ 61) | | Co-Sel. 24 (AY 52, AX 52) | | BK 1-14 |
| 68 (BJ 68) | | ----- | | BK 40 (&-) |
| 70 (BJ 70) | | ----- | | BK 35 (Entry ø) |
| 76 (BJ 76) | | P. Sel. 15 (Com. & Tr., N 67, L 67)<br>Co-Sel. 24 (AX 48, AY 48) | | BI 36 (Entry ø) |
| 77 (BJ 77) | | Co-Sel. 23 (AY 46, AX 46) | | BL 1-14 |
| 79 (BJ 79) | | Co-Sel. 27 (BB 54, BA 54)<br>Co-Sel. 23 (AY 47, AX 47) | | BK 1-14 |
| 85 (BL 45) | | Co-Sel. 23 (AY 44, AX 44) | | BL 1-14 |
| 87 (BL 47) | | P. Sel. 4 (K 56, J 56)<br>Co-Sel. 23 (AY 45, AX 45) | | BK 1-14 |

M) ZERO PRINT CONTROL JACK-PLUGGED FIELDS

| Field | Jack-Plugged to | Field |
|---|---|---|
| BG 45 | | BH 45 |
| BG 48-49 | | BH 48-49 |
| BG 57-59 | | BH 57-59 |
| BG 75-78 | | BH 75-78 |
| BI 44-47 | | BJ 44-47 |
| BI 51 | | BJ 51 |
| BI 53-58 | | BJ 53-58 |
| BI 60 | | BJ 60 |
| BI 62-66 | | BJ 62-66 |
| BI 69 | | BJ 69 |
| BI 71-74 | | BJ 71-74 |
| BI 80 | | BJ 80 |
| BK 41-43 | | BL 41-43 |
| BK 48-58 | | BL 48-58 |
| BK 67-72 | | BL 67-72 |

Symbolic Listing of Sediment Description Program (# 0212) for IBM 650 Computer

```
               IDF     0212
               P5C
    1
    1            PROGRAM TO COMPUTE RESULTS OF
    1            SEDIMENT ANALYSES USED IN
    1            MARINE GEOLOGY
    1
    1            WRITTEN BY  EUGENE E. COLLIAS
    1
    1            ROUTINE 0212
    1            WRITTEN JANUARY 1960
    1            REVISED AUGUST 1960
    1            REVISED JANUARY 1963
    1
    1            PSEUDO OPS
    1
               BLR     0000     0000
               BLR     1686     1999     SUBROUTINS
    1
               REG     R0001    0010     READ REG
               REG     P0027    0036     PUNCH REG
    1
               REG     T1400    1499     T-TABLE
    1
               REG     A1500    1549     PHI SIZES
               REG     B1550    1599     ACUM PRCT
               REG     C1600    1649     T-VALUES
               REG     D1650    1670     FAND W TLU
               REG     E1671    1680     TEMP STORG
               REG     M1681    1685     TMP STORAG
    1
               SYN     START    0200
    1
               SYN     Y1       0500     PHI TERMS
               SYN     Y2       0510     OF
               SYN     Y3       0520     INTRPOLATN
               SYN     Y4       0530     ROUTINE
    1
               SYN     X1       0550     PERCENT
               SYN     X2       0560     TERMS OF
               SYN     X3       0570     INTRPOLATN
               SYN     X4       0580     ROUTINE
    1
               SYN     XX       0600
    1
               SYN     AA       0150
               SYN     AAB      0146
               SYN     BA       0140
               SYN     BAB      0136
    1
    1
               SYN     L117     0117     SEE CARDS
               SYN     L096     0096     0831, 0838
    1
               SYN     DISTB    8001
               SYN     LOWER    8002
               SYN     UPPER    8003
    1
    1            INSERT FIVE PER CARD LOADING
    1            ROUTINE HERE
    1
               REL      9999    1700
               REQ     SQURT    0001
    1            INSERT SUBROUTINE 5001 HERE
    1
               REL      9999    1750
               REQ     ELRGX    0000
```

```
 1               INSERT SUBROUTINE 5508 HERE
 1
 1
               REL     9999     1800
               REQ     LOG10    0055
 1               INSERT SUBROUTINE 5002 HERE
 1
       START   RCD     R0011    INITL    READFIRST        0200   70 0011 0011
 1                                       CARD, THEN
 1                                       INITIALIZE
 1
       DATA1   LDD     R0001             MOVE CRUIS       0050   69 0001 0054
               STD     P0001              NUMBER          0054   24 0027 0080
 1
               LDD     R0002             MOVE STAT        0080   69 0002 0055
               STD     P0002             NO + SMPLR       0055   24 0028 0081
 1                                        TYPE
 1
               LDD     R0003             MOVE             0081   69 0003 0056
               STD     P0003              POSITION        0056   24 0029 0082
 1
               RAL     R0004             CHANGE           0082   65 0004 0059
               SRT      0001              CARD TYPE       0059   30 0001 0015
               SLT      0001              TO NO. 2        0015   35 0001 0021
               ALO     TWO00                              0021   15 0024 0079
               STL     P0004                              0079   20 0030 0083
 1
               RAM     R0005             SEPARATE         0083   67 0005 0109
               STD     P0005              DEPTH           0109   24 0031 0084
               SLT      0005                              0084   35 0005 0047
               STU     E0001                              0047   21 1671 0074
 1
               RAU     R0005             AND PHI-         0074   60 0005 0159
               SLT      0005             SIZE             0159   35 0005 0071
               SRT      0006                              0071   30 0006 0085
               AUP     PHI10                              0085   10 0038 0043
               STU     A0002                              0043   21 1501 0104
               STD     PHIA                               0104   24 0057 0060
 1
               RAU     R0006             IS FIRST         0060   60 0006 0061
               STD     B0002             PERCENT          0061   24 1551 0154
               NZU              OK       ZERO             0154   44 0107 0058
 1
               RAU     E0004             NO SO STOP       0107   60 1674 0129
               ALO     DISTB    DISTB                     0129   15 8001 8001
       E0004   HLT      1999    START                     1674   01 1999 0200
 1
       OK      ALO     SUMMP                              0058   15 0111 0065
               STL     P0006                              0065   20 0032 0135
 1
               RSL     4.090             SET FIRST        0135   66 0088 0093
               STL     P0007             T-VALUE          0093   20 0033 0086
               STD     C0002             TO -4.090        0086   24 1601 0204
 1
               RAU     R0007             CHECK IF         0204   60 0007 0161
               SRT      0005             POST             0161   30 0005 0023
               STU     PAWT              ANALYTICAL       0023   21 0078 0131
               RAU     LOWER             WEIGHT           0131   60 8002 0039
               AUP     PAWT              EXCEEDS          0039   10 0078 0133
               STU     PAWT              100 GRAMS        0133   21 0078 0181
 1
               PCH     P0001             PUNCH CARD       0181   71 0027 0077
 1
               LDD     ONEEE             SET CARD         0077   69 0130 0183
               STD     CRDCT    DATA2    COUNT = 1        0183   24 0186 0089
 1
       DATA2   RCD     R0001             READ NEXT        0089   70 0001 0051
 1                                        DATA CARD
 1
 1              CHECK IF THIS IS THE SAME SMPL
 1
               RAU     R0001             IS THIS          0051   60 0001 0105
               SUP     P0001             THE SAME         0105   11 0027 0231
```

```
                NZU   LAST              CRUISE          0231  44 0185 0236
    1
                RAU   R0003             YES, SO IS      0236  60 0003 0157
                SUP   P0003             EXTRA ID        0157  11 0029 0233
                NZU   LAST              THE SAME        0233  44 0185 0138
    1
                RAU   R0002             YES, SO IS      0138  60 0002 0207
                SUP   P0002             STAT NO         0207  11 0028 0283
                NZU   LAST              THE SAME        0283  44 0185 0188
    1
                RAM   R0005             YES, SO IS      0188  67 0005 0209
                STD   P0005             SAME DEPTH      0209  24 0031 0134
                SLT    0005             AS ON           0134  35 0005 0097
                SUP   E0001             FIRST CARD      0097  11 1671 0025
                NZU   LAST                              0025  44 0185 0180
    1
    1
                RAU   R0005             SAME            0180  60 0005 0259
                SLT    0005             SAMPLE SO       0259  35 0005 0121
                SRT    0006             MOVE PHI        0121  30 0006 0235
                AUP   PHI10    AA111    AND ADD         0235  10 0038 0143
        AA111   STU   A0003    AA11     TEN TO IT       0143  21 1502 0155
        AA11    STD   PHIB                              0155  24 0108 0211
    1
                RAL   PHIA              IS PHIB         0211  65 0057 0261
                SLO   PHIB              LARGER          0261  16 0108 0013
                BMI   E0006             THAN PHIA       0013  46 1676 0017
    1
                RAU   E0005             PHIB IS         0017  60 1675 0179
                SLO   DISTB    DISTB    SMALLER         0179  16 8001 8001
        E0005   HLT    1999    START    SO STOP         1675  01 1999 0200
    1
        E0006   STD   PHIA              PHIB            1676  24 0057 0110
    1                                   LARGER SO
                RAL   R0006             SEPARATE        0110  65 0006 0311
                SLT    0005             PERCENT         0311  35 0005 0073
    1
                NZU   A12               IS IT ZERO      0073  44 0127 0128
    1
                RAU   R0007             YES, SO         0128  60 0007 0361
                SLT    0005             CALCULATE       0361  35 0005 0123
                RAL   UPPER             PERCENT         0123  65 8003 0281
                SLT    0002             FROM            0281  35 0002 0037
    1
                RAU   UPPER             FRACTION        0037  60 8003 0045
                SLT    0005             WEIGHTS         0045  35 0005 0257
                AUP   R0006                             0257  10 0006 0411
                SRT    0003                             0411  30 0003 0019
                DVR   PAWT                              0019  64 0078 0139
                SRD    0003                             0139  31 0003 0049
                SLT    0005                             0049  35 0005 0461
                STL   R0006                             0461  20 0006 0309
                SLT    0005    A12                      0309  35 0005 0127
    1
        A12     AUP   SUMMP    AA222    NO, SO          0127  10 0111 0115
        AA222   STU   B0003    A22      ACCUMULATE      0115  21 1552 0205
        A22     STD   SUMMP             PERCENT         0205  24 0111 0014
    1
                RAL   R0006             STORE           0014  65 0006 0511
                SRT    0005             FRACTION        0511  30 0005 0173
                SLT    0005             PERCENT         0173  35 0005 0285
                ALO   SUMMP             AND ACCUMD      0285  15 0111 0165
                STL   P0006             PERCENT         0165  20 0032 0335
    1
    1
                RAL   SUMMP             CALCULATE       0335  65 0111 0215
                SLO   PC100              T-VALUE        0215  16 0018 0223
                BMI   NGPC               FROM ACCM      0223  46 0026 0177
    1                                    PERCENT
                RAL   4.090             BUT CHECK       0177  65 0088 0193
                STD   DLPC     ZHH       FOR SUMMP      0193  24 0046 0099
    1                                    = 100.00
        NGPC    ALO   DISTB              OR             0026  15 8001 0333
```

```
                SLO   PC050              50.00            0333  16 0286 0041
                NZE   NT50     ZHH                        0041  45 0044 0099
        NT50    STL   DLPC                                0044  20 0046 0149
   1
                RAM   LOWER                               0149  67 8002 0307
                STL   DLPM                                0307  20 0561 0064
                SLT    0005                               0064  35 0005 0227
                STL   DLPT                                0227  20 0331 0184
   1
                RAL   ZEROS             USE TLU TO        0184  65 0087 0091
                LDD   DLPT              FIND              0091  69 0331 0234
                TLU   T0001             NEAREST           0234  84 1400 0255
                LDD   ZA                T-VALUE           0255  69 0158 0611
                SDA   ZA       ZA                         0611  22 0158 0158
        ZA      RAL   T0001                               0158  65 1400 0305
                SLT    0005                               0305  35 0005 0067
                STU   XX2               XX = PRCT         0067  21 0022 0075
                RAL   LOWER                               0075  65 8002 0383
                SLT    0005                               0383  35 0005 0095
                STU   YY2               YY = T            0095  21 0100 0053
   1
                RAL   ZA                                  0053  65 0158 0063
                SLO   DA001                               0063  16 0016 0171
                LDD   ZB                                  0171  69 0124 0277
                SDA   ZB       ZB                         0277  22 0124 0124
        ZB      RAL   T0001    ZC                         0124  65 1400 0355
        ZC      NZE   ZH                                  0355  45 0208 0359
   1
                RAL   ZB                DOES DA           0359  65 0124 0229
                SLO   DA002             OF ZB             0229  16 0132 0137
                STL   ZB                = 1400            0137  20 0124 0327
                SLO   ZD                                  0327  16 0230 0385
                NZE   ZB       ZH                         0385  45 0124 0208
   1
        ZH      SLT    0005                               0208  35 0005 0221
                STU   XX1                                 0221  21 0076 0279
                RAL   LOWER                               0279  65 8002 0187
                SLT    0005                               0187  35 0005 0199
                STU   YY1                                 0199  21 0254 0357
   1
                RAL   XX1               INTERPOLAT        0357  65 0076 0381
                SLO   XX2               T-VALUE           0381  16 0022 0377
                STL   XXD               AT THAT           0377  20 0431 0284
   1                                    PERCENTAGE
                RAU   XX1                                 0284  60 0076 0481
                SUP   DLPM                                0481  11 0561 0265
                SRT    0004                               0265  30 0004 0125
                DVR   XXD                                 0125  64 0431 0141
                STL   XXDD                                0141  20 0145 0048
   1
                RAU   YY2                                 0048  60 0100 0405
                SUP   YY1                                 0405  11 0254 0409
                MPY   XXDD                                0409  19 0145 0315
                SRD    0006                               0315  31 0006 0531
                ALO   YY1      ZHH                        0531  15 0254 0099
        ZHH     STL   TT                                  0099  20 0103 0106
   1
                RAL   DLPC                                0106  65 0046 0101
                BMI   NGDL     PSDL                       0101  46 0304 0455
   1
        NGDL    RSL   TT       TTOUT                      0304  66 0103 0407
        PSDL    RAL   TT       TTOUT                      0455  65 0103 0407
        TTOUT   STL   C0003    CDDD                       0407  20 1602 0505
        CDDD    STL   P0007                               0505  20 0033 0336
   1
                PCH   P0001             PUNCH CARD        0336  71 0027 0427
   1
                RAL   CRDCT             STEP CARD         0427  65 0186 0191
                ALO   ONEEE             COUNT BY          0191  15 0130 0435
                STL   CRDCT             ONE               0435  20 0186 0189
   1
                RAL   AA111             STEP DATA         0189  65 0143 0147
                ALO   INCDA             ADDRESS OF        0147  15 0250 0555
```

```
            STL  AA111         AA111 AND   0555  20 0143 0196
  1                            AA222 AND
            RAL  AA222         TTOUT       0196  65 0115 0069
            ALO  INCDA                     0069  15 0250 0605
            STL  AA222                     0605  20 0115 0068
  1
            RAL  TTOUT                     0068  65 0407 0661
            ALO  INCDA                     0661  15 0250 0655
            STL  TTOUT  DATA2              0655  20 0407 0089
  1
  1           END OF SAMPLE, SO BEGIN CALCS
  1
     LAST   RAL  E0001         MOVE DEPTH  0185  65 1671 0175
            SLT   0005                     0175  35 0005 0237
            STL  P0005                     0237  20 0031 0334
  1
            RAL  SUMMP          IS SUM     0334  65 0111 0365
            SLO  PC100         PERCENT     0365  16 0018 0273
            RAM  LOWER         WITHIN      0273  67 8002 0581
            SLO  SEVEN         0.06  OF    0581  16 0384 0239
            BMI  YESP          100.00      0239  46 0042 0243
  1
            RAL  SUMMP         NO, SO      0243  65 0111 0415
            STL  P0006         PUNCH       0415  20 0032 0485
  1                            ERROR
  1                            CARD
  1
            STD  P0007                     0485  24 0033 0386
            STD  P0008                     0386  24 0034 0287
            STD  P0009                     0287  24 0035 0238
  1
            PCH  P0001  INITL  PUNCH CARD  0238  71 0027 0011
  1
     YESP   RAL  CRDCT         YES, SO     0042  65 0186 0241
            SLO  FOURR         ARE THERE   0241  16 0094 0249
            BMI         YESC   MORE THAN   0249  46 0052 0203
  1                            FOUR SIZES
  1                            CLASSES
  1
            RAL  P0005         NO, SO      0052  65 0031 0535
            ALO  CRDCT         PUNCH       0535  15 0186 0291
            STL  P0005         ERROR       0291  20 0031 0434
  1                            CARD
            LDD  SUMMP                     0434  69 0111 0114
            STD  P0006  NOO                0114  24 0032 0300
  1
     YESC   RAL  AA111          YES, SO    0203  65 0143 0197
            LDD  A41           REMOVE      0197  69 0350 0253
            SDA  A41           LAST PHI    0253  22 0350 0303
            LDD  TSTAA  A41    AND         0303  69 0156 0350
     A41    STD  A0001         PERCENT     0350  24 1500 0353
  1                            FROM A
            RAL  AA222         AND B       0353  65 0115 0119
            LDD  A42           REGIONS     0119  69 0072 0225
            SDA  A42                       0225  22 0072 0275
            LDD  TSTAA  A42                0275  69 0156 0072
     A42    STD  B0001  IN5                0072  24 1550 0403
  1
     IN5    LDD  OT5           PREPARE TO  0403  69 0206 0459
            STD  OUT            INTRPOLAT  0459  24 0012 0465
            LDD  PC005          PHI 5      0465  69 0118 0271
            STD  XX                        0271  24 0600 0453
            LDD  TT005                     0453  69 0256 0509
            STD  XT                        0509  24 0062 0515
            LDD  IA                        0515  69 0168 0321
            STD  AAA                       0321  24 0174 0527
            LDD  2A                        0527  69 0280 0433
            STD  BBB    ENTR               0433  24 0436 0289
  1
     OT5    STL  PHI05                     0206  20 0711 0164
            RAL  TEST1                     0164  65 0167 0371
            ALO  BD001                     0371  15 022[illegible] 0329
            STL  TEST1  IN16               0329  20 0167 0020
```

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1
1
        IN16   LDD   OT16            PREPARE TO   0020  69 0323 0126
               STD   OUT              INTRPOLAT   0126  24 0012 0565
               LDD   PC016            PHI 16      0565  69 0218 0421
               STD   XX                           0421  24 0600 0503
               LDD   TT016                        0503  69 0306 0559
               STD   XT                           0559  24 0062 0615
               LDD   IB                           0615  69 0268 0471
               STD   AAA                          0471  24 0174 0577
               LDD   2B                           0577  69 0330 0483
               STD   BBB     ENTR                 0483  24 0436 0289
1
        OT16   STL   PHI16                        0323  20 0627 0380
               RAL   TEST1                        0380  65 0167 0521
               ALO   BD002                        0521  15 0274 0379
               STL   TEST1   IN25                 0379  20 0167 0070
1
        IN25   LDD   OT25            PREPARE TO   0070  69 0373 0176
               STD   OUT              INTRPOLAT   0176  24 0012 0665
               LDD   PC025            PHI 25      0665  69 0318 0571
               STD   XX                           0571  24 0600 0553
               LDD   TT025                        0553  69 0356 0609
               STD   XT                           0609  24 0062 0715
               LDD   IC                           0715  69 0368 0621
               STD   AAA                          0621  24 0174 0677
               LDD   2C                           0677  69 0430 0533
               STD   BBB     ENTR                 0533  24 0436 0289
1
        OT25   STL   PHI25                        0373  20 0727 0480
               RAL   TEST1                        0480  65 0167 0671
               ALO   BD003                        0671  15 0324 0429
               STL   TEST1   IN50                 0429  20 0167 0120
1
        IN50   LDD   OT50            PREPARE TO   0120  69 0423 0226
               STD   OUT              INTRPOLAT   0226  24 0012 0765
               LDD   PC050            PHI 50      0765  69 0286 0339
               STD   XX                           0339  24 0600 0603
               LDD   TT050                        0603  69 0406 0659
               STD   XT                           0659  24 0062 0815
               LDD   ID                           0815  69 0418 0721
               STD   AAA                          0721  24 0174 0777
               LDD   2D                           0777  69 0630 0583
               STD   BBB     ENTR                 0583  24 0436 0289
1
        OT50   STL   PHI50                        0423  20 0827 0680
               RAL   TEST1                        0680  65 0167 0771
               ALO   BD004                        0771  15 0374 0479
               STL   TEST1   IN75                 0479  20 0167 0170
1
        IN75   LDD   OT75            PREPARE TO   0170  69 0473 0276
               STD   OUT              INTRPOLAT   0276  24 0012 0865
               LDD   PC075            PHI 75      0865  69 0468 0821
               STD   XX                           0821  24 0600 0653
               LDD   TT075                        0653  69 0456 0709
               STD   XT                           0709  24 0062 0915
               LDD   ID                           0915  69 0418 0871
               STD   AAA                          0871  24 0174 0877
               LDD   4D                           0877  69 0730 0633
               STD   BBB     ENTR                 0633  24 0436 0289
1
        OT75   STL   PHI75                        0473  20 0927 0780
               RAL   TEST1                        0780  65 0167 0921
               ALO   BD005                        0921  15 0424 0529
               STL   TEST1   IN84                 0529  20 0167 0220
1
        IN84   LDD   OT84            PREPARE TO   0220  69 0523 0326
               STD   OUT              INTRPOLAT   0326  24 0012 0965
               LDD   PC084            PHI 84      0965  69 0518 0971
               STD   XX                           0971  24 0600 0703
               LDD   TT084                        0703  69 0506 0759
               STD   XT                           0759  24 0062 1015
               LDD   IE                           1015  69 0568 1021
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           STD   AAA                          1021  24 0174 0977
           LDD   2E                           0977  69 0830 0683
           STD   BBB    ENTR                  0683  24 0436 0289
 1
     OT84  STL   PHI84                        0523  20 1027 0880
           RAL   TEST1                        0880  65 0167 1071
           ALO   BD006                        1071  15 0474 0579
           STL   TEST1  IN95                  0579  20 0167 0270
 1
     IN95  LDD   OT95          PREPARE TO     0270  69 0573 0376
           STD   OUT            INTRPOLAT     0376  24 0012 1065
           LDD   PC095          PHI 95        1065  69 0618 1121
           STD   XX                           1121  24 0600 0753
           LDD   TT095                        0753  69 0556 0809
           STD   XT                           0809  24 0062 1115
           LDD   IE                           1115  69 0568 1171
           STD   AAA                          1171  24 0174 1077
           LDD   4E                           1077  69 0930 0733
           STD   BBB    ENTR                  0733  24 0436 0289
 1
     OT95  STL   PHI95                        0573  20 1127 0980
           RAL   TEST1                        0980  65 0167 1221
           ALO   BD007                        1221  15 0524 0629
           STL   TEST1  TEST2                 0629  20 0167 0320
 1
     ENTR  RAL   ZEROS         USING TLU      0289  65 0087 0341
           LDD   XX             FIND CELL     0341  69 0600 0803
           TLU   B0001          NEAREST       0803  84 1550 0705
           STL   TPSTT          TO XX         0705  20 0859 0112
           STD   TPST           PERCENT       0112  24 1165 0668
 1
           RAL   SUML1         IS SUML1       0668  65 1271 0325
           SLO   XX             SMALLER       0325  16 0600 0755
           BMI   MAX            THAN XX       0755  46 0258 0909
 1
           RAL   TPSTT         NO, SO IS      0909  65 0859 0113
           LDD   T1             VALUE OF      0113  69 0066 0169
           SDA   T1     DISTB   BX EQUAL      0169  22 0066 8001
     T1    RAL   B0001          TO XX         0066  65 1550 0805
           SLO   XX                           0805  16 0600 0855
           NZE   CMPT                         0855  45 0308 0959
 1
           RAL   TPSTT         YES            0959  65 0859 0163
           SLO   DA050                        0163  16 0116 1321
           LDD   T2                           1321  69 0574 1177
           SDA   T2     DISTB                 1177  22 0574 8001
     T2    RAL   B0001                        0574  65 1550 0905
           SLO   PHI10  OUT                   0905  16 0038 0012
 1
     CMPT  RAL   TPSTT         IS CONTENT     0308  65 0859 0213
           ALO   INCDA          OF TPST       0213  15 0250 0955
           LDD   T21            PLUS ONE      0955  69 0358 0761
           SDA   T21    DISTB   99999         0761  22 0358 8001
     T21   RAL   B0001                        0358  65 1550 1005
           SLO   TSTAA                        1005  16 0156 0811
           NZE   NO1    YES1                  0811  45 0214 1215
 1
     NO1   RAL   TPSTT         IS CONTENT     0214  65 0859 0263
           SLO   DA002          OF TPST       0263  16 0132 0337
           LDD   T23            LESS TWO      0337  69 0040 0293
           SDA   T23    DISTB   ZERO          0293  22 0040 8001
     T23   RAL   B0001                        0040  65 1550 1055
           NZE   STOR   YES2                  1055  45 0408 1009
 1
     YES1  RAL   TPSTT         REDUC TPST     1215  65 0859 0313
           SLO   INCDA          BY ONE        0313  16 0250 1105
           STL   TPSTT                        1105  20 0859 0162
           LDD   ATESS                        0162  69 0153 0606
           STD   TEST6  STOR                  0606  24 1059 0408
 1
     YES2  RAL   TPSTT         IS TPSTT       1009  65 0859 0363
           SLO   DA002          LESS 2        0363  16 0132 0387
           SLO   DA551          1551 OR       0387  16 0090 0195
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              BMI   NO2     STOR     LARGER          0195  46 0098 0408
     1
     NO2      RAL   TPSTT            ADD ONE         0098  65 0859 0413
              ALO   INCDA             TO TPSTT       0413  15 0250 1155
              STL   TPSTT                            1155  20 0859 0212
              LDD   ATESS                            0212  69 0153 0656
              STD   TEST6   STOR                     0656  24 1059 0408
     1
     MAX      RAL   TPSTT                            0258  65 0859 0463
              SLO   DA002                            0463  16 0132 0437
              STL   TPSTT                            0437  20 0859 0262
     1
              LDD   TEST1            FIND HIEST      0262  69 0167 0370
              BD1   NOP               VALUE OF       0370  91 0623 0375
              BD2   NOP               ACCUMULTD      0375  92 0623 1030
              BD3   NOP               PERCENT        1030  93 0623 0585
              BD4   NOP               WHICH CAN      0585  94 0623 0190
              BD5   EX75             BE              0190  95 0343 0245
              BD6   EX84              EXTRAPLTD      0245  96 0148 0400
              BD7   EX95    NOP                      0400  97 0853 0623
     1
     EX75     RAL   SUML1            CAN PHI-75      0343  65 1271 0425
              SLO   PC072             BE             0425  16 0178 0783
              BMI   NOP               EXTRAPLTD      0783  46 0623 0487
     1
              LDD   TT075            YEX, SO         0487  69 0456 1109
              STD   XT                SET EXTP       1109  24 0062 1265
              RSL   P0005             CODE           1265  66 0031 0635
              SLO   ONEEE                            0635  16 0130 0685
              STL   P0005                            0685  20 0031 0484
     1
              RAL   TEST3            SET TEST 3      0484  65 0537 0391
              ALO   BD003            SO AS NOT       0391  15 0324 0679
              ALO   BD002            TO CALC FW      0679  15 0274 0729
              STL   TEST3             OR INMAN       0729  20 0537 0240
     1                                VALUES
              LDD   OT75X                            0240  69 0393 0246
              STD   OUT     STOR                     0246  24 0012 0408
     1
     OT75X    STL   PHI75   TEST2                    0393  20 0927 0320
     1
     EX84     RAL   SUML1            CAN PHI-84      0148  65 1271 0475
              SLO   PC081             BE EXTPLD      0475  16 0228 0833
              BMI   NOPA                             0833  46 0486 0587
     1
              LDD   TT084            YES, SO         0587  69 0506 1159
              STD   XT                SET            1159  24 0062 1315
              RSL   P0005             EXTP CODE      1315  66 0031 0735
              SLO   TW000                            0735  16 0024 0779
              STL   P0005                            0779  20 0031 0534
     1
              RAL   TEST3            SET TEST 3      0534  65 0537 0441
              ALO   BD003             SO DO NOT      0441  15 0324 0829
              STL   TEST3             CALCULATE      0829  20 0537 0290
     1                                FOLK AND
              LDD   ATESS             WARD           0290  69 0153 0706
              STD   TEST6             VALUES         0706  24 1059 0312
              LDD   OT84X                            0312  69 1365 0718
              STD   OUT     STOR                     0718  24 0012 0408
     1
     1
     OT84X    STL   PHI84   TEST2                    1365  20 1027 0320
     1
     EX95     RAL   SUML1            CAN PHI-95      0853  65 1271 0525
              SLO   PC092             BE             0525  16 0278 0883
              BMI   NOPB              EXTRAPLTD      0883  46 0536 0637
     1
              LDD   TT095            YES, SO         0637  69 0556 1209
              STD   XT                SET EXTP       1209  24 0062 0166
              RSL   P0005             CODE           0166  66 0031 0785
              SLO   THREE                            0785  16 0288 0443
              STL   P0005                            0443  20 0031 0584
     1
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               LDD    ATESS                          0584  69 0153 0756
               STD    TEST6                          0756  24 1059 0362
 1
               LDD    OT95X                          0362  69 0216 0219
               STD    OUT      STOR                  0219  24 0012 0408
 1
       OT95X   STL    PHI95    TEST2                 0216  20 1127 0320
 1
       NOP     RAL    TEST3             NO VALUES    0623  65 0537 0491
               ALO    BD003              CAN BE      0491  15 0324 0879
               ALO    BD002              CALCULATD   0879  15 0274 0929
               ALO    BD001                          0929  15 0224 0979
               STL    TEST3    TEST2                 0979  20 0537 0320
 1
       NOPA    RAL    TEST3             PHI-75       0486  65 0537 0541
               ALO    BD003              CALCD BUT   0541  15 0324 1029
               ALO    BD002              PHI-84      1029  15 0274 1079
               STL    TEST3    TEST2     CANT BE     1079  20 0537 0320
 1
       NOPB    RAL    TEST3             PHI-84       0536  65 0537 0591
               ALO    BD003              CALCD BUT   0591  15 0324 1129
               STL    TEST3    TEST2     PHI-95      1129  20 0537 0320
 1                                       CANT BE
 1
 1
 1                THE INTERPOLATION METHOD OF
 1                AITKENS SUCCESSIVE ITERATIONS
 1                USING FOUR POINTS
 1
 1                X VALUES ARE T-VALUES
 1                   AND
 1                Y VALUES ARE PHI SIZES
 1
       STOR    RAL    TPSTT             LOAD         0408  65 0859 0513
               SLO    DA002              T-VALUES    0513  16 0132 0687
               ALO    DA050              INTO X      0687  15 0116 1371
               LDD    INX                CELLS AND   1371  69 0624 1227
               SDA    INX                PHI         1227  22 0624 1277
               SLO    DA100              VALUES      1277  16 1080 0835
               LDD    INY                INTO Y      0835  69 0338 0641
               SDA    INY      INX       CELLS       0641  22 0338 0624
       INX     LDD    C0001    M0001                 0624  69 1600 1681
       M0001   STD    X1       INY                   1681  24 0550 0338
       INY     LDD    A0001    M0002                 0338  69 1500 1682
       M0002   STD    Y1       M0003                 1682  24 0500 1683
       M0003   RAL    TEST4                          1683  65 0586 0691
               SLO    ONEEE                          0691  16 0130 0885
               STL    TEST4                          0885  20 0586 0389
               NZE             COMNS                 0389  45 0092 0493
 1
               RAL    INX               STEP DATA    0092  65 0624 1179
               ALO    INCDA              ADDRESSES   1179  15 0250 1205
               STL    INX                INX THRU    1205  20 0624 1327
               RAL    M0001              M0002 BY    1327  65 1681 0935
               ALO    DA010              TEN         0935  15 0388 0543
               STL    M0001                          0543  20 1681 0634
               RAL    INY                            0634  65 0338 0593
               ALO    INCDA                          0593  15 0250 1255
               STL    INY                            1255  20 0338 0741
               RAL    M0002                          0741  65 1682 0737
               ALO    DA010                          0737  15 0388 0643
               STL    M0002    INX                   0643  20 1682 0624
 1
       COMNS   LDD    ORGM1             RESTORE      0493  69 0296 0299
               STD    M0001             M0001 AND    0299  24 1681 0684
               LDD    ORGM2             M0002        0684  69 0787 0340
               STD    M0002             BEFORE       0340  24 1682 0985
               LDD    FOURR             INTRPOLATN   0985  69 0094 0247
               STD    TEST4                          0247  24 0586 0439
               LDD    XT                             0439  69 0062 0266
               STD    XX       AIKNS                 0266  24 0600 0903
 1
 1
```

```
      AIKNS  RAU   X2               AITKENS          0903  60  0560  0316
             SUP   X1                METHOD          0316  11  0550  1305
             SRT    0004            FIRST            1305  30  0004  0366
             STL   X21               ITERATION       0366  20  0122  0575
             NZE              ST                     0575  45  0328  1229
 1
             RAU   X1                                0328  60  0550  1355
             SUP   XX                                1355  11  0600  0806
             STU   X1X                               0806  21  0160  0563
             MPY   Y2                                0563  19  0510  0631
             STL   X1Y2                              0631  20  1035  0438
 1
             RAU   X2                                0438  60  0560  0416
             SUP   XX                                0416  11  0600  0856
             STU   X2X                               0856  21  0210  0613
             MPY   Y1                                0613  19  0500  0172
             SLO   X1Y2                              0172  16  1035  0489
 1
             RAU   LOWER                             0489  60  8002  0297
             DVR   X21                               0297  64  0122  0933
             STL   I12                               0933  20  0837  0390
 1
 1
             RAU   X3               SECOND           0390  60  0570  0625
             SUP   X1                ITERATION       0625  11  0550  0906
             SRT    0004                             0906  30  0004  0217
             STL   X31                               0217  20  0222  0675
             NZE              ST                     0675  45  0378  1229
 1
             RAU   X1X                               0378  60  0160  0466
             MPY   Y3                                0466  19  0520  0791
             STL   X1Y3                              0791  20  0295  0198
 1
             RAU   X3                                0198  60  0570  0725
             SUP   XX                                0725  11  0600  0956
             STU   X3X                               0956  21  0260  0663
             MPY   Y1                                0663  19  0500  0272
             SLO   X1Y3                              0272  16  0295  0349
 1
             RAU   LOWER                             0349  60  8002  0457
             DVR   X31                               0457  64  0222  0983
             STL   I13                               0983  20  0887  0440
 1
 1
             RAU   X4               THIRD            0440  60  0580  1085
             SUP   X1                ITERATION       1085  11  0550  1006
             SRT    0004                             1006  30  0004  0267
             STL   X41                               0267  20  0322  0775
             NZE              ST                     0775  45  0428  1229
 1
             RAU   X1X                               0428  60  0160  0516
             MPY   Y4                                0516  19  0530  0151
             STL   X1Y4                              0151  20  1056  1259
 1
             RAU   X4                                1259  60  0580  1135
             SUP   XX                                1135  11  0600  1106
             STU   X4X                               1106  21  0310  0713
             MPY   Y1                                0713  19  0500  0372
             SLO   X1Y4                              0372  16  1056  0861
 1
             RAU   LOWER                             0861  60  8002  0269
             DVR   X41                               0269  64  0322  1033
             STL   I14                               1033  20  0937  0490
 1
 1
             RAU   X3               FOURTH           0490  60  0570  0825
             SUP   X2                ITERATION       0825  11  0560  0566
             SRT    0004                             0566  30  0004  1377
             STL   X32                               1377  20  0681  0734
             NZE              ST                     0734  45  0488  1229
             RAU   X2X                               0488  60  0210  0616
             MPY   I13                               0616  19  0887  0507
             SRD    0003                             0507  31  0003  0317
```

```
                STL   X21A                               0317 20 0422 0875
     1
                RAU   X3X                                0875 60 0260 0666
                MPY   I12                                0666 19 0837 0557
                SRD    0003                              0557 31 0003 0367
                SLO   X21A                               0367 16 0422 0478
     1
                RAU   LOWER                              0478 60 8002 0987
                DVR   X32                                0987 64 0681 0841
                STL   I123                               0841 20 0345 0248
     1
     1
                RAU   X4            FIFTH                0248 60 0580 1185
                SUP   X2             ITERATION           1185 11 0560 0716
                SRT    0004                              0716 30 0004 0528
                STL   X42                                0528 20 1083 0636
                NZE         ST                           0636 45 0540 1229
                RAU   X2X                                0540 60 0210 0766
                MPY   I14                                0766 19 0937 0607
                SRD    0003                              0607 31 0003 0417
                STL   X21B                               0417 20 0472 0925
     1
                RAU   X4X                                0925 60 0310 0816
                MPY   I12                                0816 19 0837 0657
                SRD    0003                              0657 31 0003 0467
                SLO   X21B                               0467 16 0472 0578
     1
                RAU   LOWER                              0578 60 8002 1037
                DVR   X42                                1037 64 1083 0693
                STL   I124                               0693 20 0347 0450
     1
     1
                RAU   X4            SIXTH AND            0450 60 0580 1235
                SUP   X3             FINAL               1235 11 0570 0975
                SRT    0004          ITERATION           0975 30 0004 1285
                STL   X43                                1285 20 0539 0142
                NZE         ST                           0142 45 0346 1229
                RAU   X3X                                0346 60 0260 0866
                MPY   I124                               0866 19 0347 0517
                SRD    0003                              0517 31 0003 0628
                STL   X31C                               0628 20 1133 0686
     1
                RAU   X4X                                0686 60 0310 0916
                MPY   I123                               0916 19 0345 0966
                SRD    0003                              0966 31 0003 0678
                SLO   X31C                               0678 16 1133 1087
     1
                SLT    0008                              1087 35 0008 1156
                DVR   X43                                1156 64 0539 0399
                SRD    0004                              0399 31 0004 0911
                SLO   PHI10                              0911 16 0038 0743
                STL   PHIAK ST                           0743 20 0397 1229
     1
          ST    RAL   TEST6         DO XS + YS           1229 65 1059 0763
                NZE   YESI  NOI     NEED TO BE           0763 45 1016 0567
     1                               CHANGED
     1
          YESI  RAL   TPST          BEFORE               1016 65 1165 0319
                ALO   DA050          LINEAR              0319 15 0116 0522
                LDD   LIA            INTERP              0522 69 1025 0728
                SDA   LIA   DISTB                        0728 22 1025 8001
          LIA   LDD   B0001 AA                           1025 69 1550 0150
          AA    STD   X3                                 0150 24 0570 0673
                SLO   DA100                              0673 16 1080 1335
                LDD   LIB                                1335 69 0538 0891
                SDA   LIB   DISTB                        0891 22 0538 8001
          LIB   LDD   A0001 BA                           0538 69 1500 0140
          BA    STD   Y3                                 0140 24 0520 0723
                RAL   LIA                                0723 65 1025 1279
                SLO   DI104 LOWER                        1279 16 0182 8002
          AAB   STD   X2                                 0146 24 0560 0813
                RAL   LIB                                0813 65 0538 0793
                SLO   DI104 LOWER                        0793 16 0182 8002
```

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        BAB    STD   Y2      NOI                   0136  24 0510 0567
 1
        NOI    RAU   X3              LINEAR        0567  60 0570 1075
               SUP   X2               INTERPLAT    1075  11 0560 1066
               STU   E0002                         1066  21 1672 I125
 1
               RAU   XX                            I125  60 0600 1206
               SUP   X2                            1206  I1 0560 1116
               SRT    0004                         1116  30 0004 0778
               DVR   E0002                         0778  64 1672 1183
               STL   E0003                         1183  20 1673 0426
 1
               RAU   Y3                            0426  60 0520 1175
               SUP   Y2                            1175  11 0510 1166
               MPY   E0003                         1166  19 1673 0843
               SRD    0006                         0843  31 0006 I309
               ALO   Y2                            1309  15 0510 1216
               SLO   PHI10                         1216  16 0038 0893
               STL   PHILN                         0893  20 0447 0650
 1
               SLO   PHIAK           IS PHI BY     0650  16 0397 0201
               RAM   LOWER            AITKENS      0201  67 8002 1359
               SLO   TWNTY            CLOSE TO     1359  16 0412 0617
               BMI   YESJ    NOJ     LINEAR INT    0617  46 0420 0572
 I
        YESJ   RAL   TPSTT           IS CALCD      0420  65 0859 0863
               SLO   DA050            PHI LARGR    0863  16 0116 0622
               LDD   TA               THAN PHI     0622  69 1225 0828
               SDA   TA      DISTB    AT TPSTT     0828  22 1225 8001
        TA     RAL   A0001   L1I7                  1225  65 1500 0117
        L117   SLO   PHI10                         0117  16 0038 0993
               BMI   NOJ                           0993  46 0572 0497
 1
 1
               RAL   TA               AND LESS     0497  65 1225 1329
               SLO   CDATT   LOWER    THAN PHI     1329  16 0232 8002
        L096   SLO   PHIAK            AT TPSTT     0096  16 0397 0251
               SLO   PHI10            LESS ONE     0251  16 0038 1043
               BMI           NOJ                   1043  46 0396 0572
 I
               RAL   TEST7           AITKENS       0396  65 0449 0953
               ALO   AAA              VALUE        0953  15 0174 1379
               STL   TEST7            GOOD         1379  20 0449 0102
               LDD   ZEROS                         0102  69 0087 0590
               STD   TEST6                         0590  24 I059 0462
               RAL   PHIAK   OUT                   0462  65 0397 00I2
 1
        NOJ .  RAL   TEST7           LINEAR        0572  65 0449 I003
               ALO   BBB              VALUE        1003  15 0436 0941
               STL   TEST7            BETTER       0941  20 0449 0152
               LDD   ZEROS                         0152  69 0087 0640
               STD   TEST6                         0640  24 1059 0512
               RAL   PHILN   OUT                   0512  65 0447 0012
 1
        PCHFI  RAM   PHI05           PREPARE TO    0700  67 0711 1266
               SLT    0005            PUNCH PHI    I266  35 0005 1130
               AML   PHI16            VALUES       1130  I7 0627 073I
               STL   P0006                         073I  20 0032 1385
 1
               RAM   PHI25                         I385  67 0727 078I
               SLT    0005                         078I  35 0005 1093
               AML   PHI50                         I093  17 0827 0831
               STL   P0007                         0831  20 0033 0736
 I
               RAM   PHI75                         0736  67 0927 0881
               SLT    0005                         088I  35 0005 1143
               AML   PHI84                         1143  17 1027 093I
               STL   P0008                         0931  20 0034 1137
 I
               RAM   PHI95                         1137  67 1127 0981
               SLT    0005                         0981  35 0005 1193
               ALO   TEST7                         1193  15 0449 1053
               STL   P0009                         1053  20 0035 0588
```

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1
            LDD   CW010                           0588  69 0991 0144
            STD   P0010                           0144  24 0036 0589
1
            RAL   PH105            TEST FOR       0589  65 0711 1316
            BM1           TS16      NEGATIVE      1316  46 0369 0470
            RAL   CW001             VALUES        0369  65 0672 0878
            ALO   P0010                           0878  15 0036 1041
            STL   P0010   TS16                    1041  20 0036 0470
1
    TS16    RAL   PH116                           0470  65 0627 1031
            BM1           TS25                    1031  46 0784 0786
            RSL   P0006                           0784  66 0032 1187
            STL   P0006   TS25                    1187  20 0032 0786
1
    TS25    RAL   PH125                           0786  65 0727 1081
            BM1           TS50                    1081  46 0834 0836
            RAL   CW002                           0834  65 1237 1091
            ALO   P0010                           1091  15 0036 1141
            STL   P0010   TS50                    1141  20 0036 0836
1
    TS50    RAL   PH150                           0836  65 0827 1131
            BM1           TS75                    1131  46 0884 0886
            RSL   P0007                           0884  66 0033 1287
            STL   P0007                           1287  20 0033 0936
            LDD   CW001                           0936  69 0672 1275
            STD   P1CW    TS75                    1275  24 0928 0886
1
    TS75    RAL   PH175                           0886  65 0927 1181
            BM1           TS84                    1181  46 0934 0986
            RAL   CW003                           0934  65 1337 1191
            ALO   P0010                           1191  15 0036 1241
            STL   P0010   TS84                    1241  20 0036 0986
1
    TS84    RAL   PH184                           0986  65 1027 1231
            BM1           TS95                    1231  46 0984 1036
            RSL   P0008                           0984  66 0034 0639
            STL   P0008   TS95                    0639  20 0034 1036
1
    TS95    RAL   PHI95                           1036  65 1127 1281
            BM1           PCHF                    1281  46 1034 1086
            RAL   CW004                           1034  65 1387 1291
            ALO   P0010                           1291  15 0036 1341
            STL   P0010   PCHF                    1341  20 0036 1086
1
    PCHF    RAL   P0004            SET CARD       1086  65 0030 1136
            SRT    0001             TYPE          1136  30 0001 1243
            SLT    0001             NO.  3        1243  35 0001 0499
            ALO   THREE                           0499  15 0288 1293
            STL   P0004                           1293  20 0030 1233
1
            PCH   P0001            PUNCH PH1      1233  71 0027 0978
1                                   VALUES
1
    1A       00    0001    0000    CONSTANT       0168  00 0001 0000
    18       00    0000    1000    CONSTANT       0268  00 0000 1000
    1C       00    0000    0100    CONSTANT       0368  00 0000 0100
    1D       00    0000    0010    CONSTANT       0418  00 0000 0010
    IE       00    0000    0001    CONSTANT       0568  00 0000 0001
1
    2A       00    0002    0000    CONSTANT       0280  00 0002 0000
    28       00    0000    2000    CONSTANT       0330  00 0000 2000
    2C       00    0000    0200    CONSTANT       0430  00 0000 0200
    2D       00    0000    0020    CONSTANT       0630  00 0000 0020
    2E       00    0000    0002    CONSTANT       0830  00 0000 0002
1
    4D       00    0000    0040    CONSTANT       0730  00 0000 0040
    4E       00    0000    0004    CONSTANT       0930  00 0000 0004
1
    ORGA1   STU   A0003   AA11     CONSTANT       0750  21 1502 0155
    ORGA2   STU   B0003   A22      CONSTANT       0800  21 1552 0205
    ORGOT   STL   C0003   CDDD     CONSTANT       0850  20 1602 0505
    ORGM1   STD   X1      1NY      CONSTANT       0296  24 0550 0338
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     ORGM2   STD   Y1      M0003    CONSTANT         0787  24 0500 1683
 1
     ZD      RAL   T0001   ZC       CONSTANT         0230  65 1400 0355
 1
 1
             PST
             CLH
             RAL   TEST3            INDICATE         0978  65 0537 1391
             ALO   BD005             PHI VALUS       1391  15 0424 1180
             STL   TEST3   CC2       COMPLETED       1180  20 0537 0690
 1
     TEST2   LDD   TEST3   CC2      DECIDE           0320  69 0537 0690
     CC2     BD5   PCHFI             WHICH           0690  95 0700 0395
             BD4   SSCLY             RESULTS         0395  94 0298 0900
             BD1   TRASK             ARE TO BE       0900  91 1103 1256
             BD2   INMAN             COMPUTED        1256  92 0360 0961
             BD3   FANDW   INITL                     0961  93 0264 0011
 1
 1              CALCULATE SAND SILT CLAY
 1              RELATIONSHIPS
 1
     SSCLY   RAL   ZEROS            FIND PRCT        0298  65 0087 0192
             LDD   PHI4              SAND BY         0192  69 0445 0348
             TLU   A0001             USING TLU       0348  84 1500 1306
             ALO   DA050                             1306  15 0116 0722
             LDD   H1                                0722  69 1325 1028
             SDA   H1      DISTB                     1028  22 1325 8001
     H1      RSL   BX                                1325  66 1078 1283
             STD   SAND                              1283  24 1186 0689
             ALO   SUMMP                             0689  15 0111 1366
             STL   SHALE                             1366  20 0772 1375
 1
             RAL   PHIB             IS PHIB          1375  65 1128 1333
             SLO   PHI8             LARGER           1333  16 1236 0242
             BMI   NO9     YES9     THAN  8          0242  46 0495 0446
     NO9     RAL   SUMMP                             0495  65 0111 0667
             SLO   SAND                              0667  16 1186 0292
             STL   SILT                              0292  20 0547 0950
             LDD   ZEROS                             0950  69 0087 0740
             STD   CLAY    NXS                       0740  24 1343 0496
 1
     YES9    RAL   ZEROS            FIND PRCT        0446  65 0087 0342
             LDD   PHI8              SILT BY         0342  69 1236 0739
             TLU   A0001             USING TLU       0739  84 1500 1356
             ALO   DA050                             1356  15 0116 0822
             LDD   H2                                0822  69 0476 1230
             SDA   H2      DISTB                     1230  22 0476 8001
     H2      RAL   BX                                0476  65 1078 1383
             SLO   SAND                              1383  16 1186 0392
             STL   SILT                              0392  20 0547 1000
 1
             RAL   SUMMP            CALC PRCT        1000  65 0111 0717
             SLO   SAND              CLAY            0717  16 1186 0442
             SLO   SILT                              0442  16 0547 0301
             STL   CLAY    NXS                       0301  20 1343 0496
 1
     NXS     RAL   ZEROS            CALC PRCT        0496  65 0087 0492
             LDD   PHI-1             FRACTION        0492  69 0545 0398
             TLU   A0001             OF SAMPLE       0398  84 1500 0707
             ALO   DA050             LARGER          0707  15 0116 0872
             LDD   H3                THAN SAND       0872  69 0526 1280
             SDA   H3      DISTB                     1280  22 0526 8001
     H3      LDD   BX                                0526  69 1078 1331
             STD   LRGSN                             1331  24 1084 0638
             RAL   SAND             CALC TRUE        0638  65 1186 0542
             SLO   LRGSN             PRCT SAND       0542  16 1084 0789
             BMI   NGSN                              0789  46 0592 1393
     NGSN    RSL   LOWER                             0592  66 8002 1393
             STL   TRUSN                             1393  20 0597 1050
 1
             RAU   SHALE                             1050  60 0772 1178
             NZU           NOSH                      1178  44 1381 0282
             RAU   SAND             CALC RATIO       1381  60 1186 0642
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                SRT   0004            OF SAND TO     0642  30 0004 1153
                DVR   SHALE           MUD            1153  64 0772 1134
                SRD   0004                           1134  31 0004 0647
       NOSH     RAL   TSTAA                          0282  65 0156 0647
                STL   SA/MD                          0647  20 0351 0354
1
                LDD   ZEROS                          0354  69 0087 0790
                STD   P0009                          0790  24 0035 0688
1
                RAL   SAND            IS PRCT        0688  65 1186 0692
                SLO   PC075            SAND LRGR     0692  16 0468 0773
                BMI          SET1      THAN 75       0773  46 0576 1228
1
                RAL   SILT            NO, SO IS      0576  65 0547 0401
                SLO   PC075            PRCT SILT     0401  16 0468 0823
                BMI          SET4      LRGR THAN     0823  46 0626 1278
1                                      75
1
                RAL   CLAY            NO, SO IS      0626  65 1343 0697
                SLO   PC075            PRCT CLAY     0697  16 0468 0873
                BMI          SET10     CLAY LRGR     0873  46 0676 1328
1                                      THAN 75
1
                RAL   SAND            NO, SO IS      0676  65 1186 0742
                SLO   PC020            PRCT SAND     0742  16 0595 0549
                BMI   C                LRGR THAN     0549  46 0202 1203
1                                      20
1
                RAL   SILT            NO, SO IS      1203  65 0547 0451
                SLO   PC020            PRCT SILT     0451  16 0595 0599
                BMI   D                LRGR THAN     0599  46 0252 1253
1                                      20
1
                RAL   CLAY            NO, SO IS      1253  65 1343 0747
                SLO   PC020            PRCT CLAY     0747  16 0595 0649
                BMI   E      SET6      LRGR THAN     0649  46 0302 1303
1                                      20
1
       C        RAU   CLAY            IS RATIO       0202  60 1343 0797
                SRT   0004             CLAY/SILT     0797  30 0004 0757
                DVR   SILT             LRGR THAN     0757  64 0547 0807
                SLO   CONE             ONE           0807  16 0410 0767
                NZE   CAA                            0767  45 0620 0922
1
                LDD   N92             EXACTLY        0922  69 0726 1330
                STD   P0009  CAA       ONE           1330  24 0035 0620
1
       CAA      BMI   CA     CB                      0620  46 0923 0674
1
       CA       RAU   CLAY            IS RATIO       0923  60 1343 0847
                SRT   0004             CLAY/SAND     0847  30 0004 0857
                DVR   SAND             LRGR THAN     0857  64 1186 0897
                SLO   CONE             ONE           0897  16 0410 0817
                NZE   CAB                            0817  45 0670 0972
1
                LDD   N92             EXACTLY        0972  69 0726 1380
                STD   P0009  CAB       ONE           1380  24 0035 0670
1
       CAB      BMI   SET3   SET7                    0670  46 0973 0724
1
       CB       RAU   SAND            IS RATIO       0674  60 1186 0792
                SRT   0004             SAND/SILT     0792  30 0004 1353
                DVR   SILT             LRGR THAN     1353  64 0547 0907
                SLO   CONE             ONE           0907  16 0410 0867
                NZE   CBB                            0867  45 0720 1022
1
                LDD   N92             EXACTLY        1022  69 0726 0332
                STD   P0009  CBB       ONE           0332  24 0035 0720
1
       CBB      BMI   SET9   SET8                    0720  46 1023 0774
1
1
       D        RAU   CLAY            IS RATIO       0252  60 1343 0947
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                SRT   0004             CLAY/SAND     0947  30 0004 0957
                DVR   SAND             LRGR THAN     0957  64 1186 0997
                SLO   CONE             ONE           0997  16 0410 0917
                NZE   DAA                            0917  45 0770 1072
 1
                LDD   N92              EXACTLY       1072  69 0726 0382
                STD   P0009   DAA      ONE           0382  24 0035 0770
 1
       DAA      BMI   CC      CB                     0770  46 1073 0674
 1
       CC       RAU   CLAY             IS RATIO      1073  60 1343 1047
                SRT   0004             CLAY/SILT     1047  30 0004 1007
                DVR   SILT             LRGR THAN     1007  64 0547 1057
                SLO   CONE             ONE           1057  16 0410 0967
                NZE   DBB                            0967  45 0820 1122
 1
                LDD   N92              EXACTLY       1122  69 0726 0432
                STD   P0009   DBB      ONE           0432  24 0035 0820
 1
       DBB      BMI   SET2    SET5                   0820  46 1123 0824
 1
 1
       E        RAU   SAND             IS RATIO      0302  60 1186 0842
                SRT   0004             SAND/SILT     0842  30 0004 0404
                DVR   SILT                           0404  64 0547 1107
                SLO   CONE                           1107  16 0410 1017
                NZE   EAA                            1017  45 0870 1172
 1
                LDD   N92                            1172  69 0726 0482
                STD   P0009   EAA                    0482  24 0035 0870
 1
       EAA      BMI   CA      CC                     0870  46 0923 1073
 1
       SET1     RAL   ONEEE            SET PROPER    1228  65 0130 1286
       SET2     RAL   TWOOO            CODE          1123  65 0024 1286
       SET3     RAL   THREE            NUMBER IN     0973  65 0288 1286
       SET4     RAL   FOURR            P0008         1278  65 0094 1286
       SET5     RAL   FIVEE                          0824  65 1378 1286
       SET6     RAL   SIXXX                          1303  65 1157 1286
       SET7     RAL   SEVEN                          0724  65 0384 1286
       SET8     RAL   EIGHT                          0774  65 0532 1286
       SET9     RAL   NINEE                          1023  65 0776 1286
       SET10    RAL   TENNN                          1328  65 0582 1286
 1
                ALO   P0009                          1286  15 0035 0839
                SLT   0005                           0839  35 0005 0458
                STL   P0009                          0458  20 0035 0738
 1
                RAL   P0004            SET CARD      0738  65 0030 1336
                SRT   0001             TYPE          1336  30 0001 0194
                SLT   0001             NO. 4         0194  35 0001 0501
                ALO   FOURR                          0501  15 0094 0699
                STL   P0004                          0699  20 0030 1184
 1
                RAL   LRGSN            PACK PUNCH    1184  65 1084 0889
                SLT   0005             BANDS         0889  35 0005 0551
                ALO   TRUSN                          0551  15 0597 0601
                STL   P0006                          0601  20 0032 1386
 1
                RAL   SILT                           1386  65 0547 0651
                SLT   0005                           0651  35 0005 0913
                ALO   CLAY                           0913  15 1343 1097
                STL   P0007                          1097  20 0033 0788
 1
                RAL   SUMMP                          0788  65 0111 1067
                SLT   0005                           1067  35 0005 0632
                ALO   SA/MD                          0632  15 0351 1207
                STL   P0008                          1207  20 0034 0838
 1
                LDD   CW010                          0838  69 0991 0244
                STD   P0010                          0244  24 0036 0939
 1
                PCH   P0001            PUNCH CARD    0939  71 0027 0682
```

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1
              RAL   TEST3            INDICATE        0682  65 0537 0892
              ALO   BD004             SAND SILT      0892  15 0374 0732
              STL   TEST3    CC2      CLAY           0732  20 0537 0690
1                                     COMPLETED
1
1                CALCULATE TRASK VALUES
1
       TRASK  RAU   PHI25            CONVERT         1103  60 0727 0782
              MPY   LNE2              PHI 25 TO      0782  19 0888 0460
              LDD   NXTF     ELRGX    MILLIMTRS      0460  69 0963 1750
       NXTF   SRD    0003             FOR Q1         0963  31 0003 1173
              STL   FQ1                              1173  20 0832 0938
              SRD    0001                            0938  31 0001 0645
              STL   Q1                               0645  20 0749 0352
1
              RAU   PHI50            CONVERT         0352  60 0827 0882
              MPY   LNE2                             0882  19 0888 0610
              LDD   NXTG     ELRGX    MILLIMTRS      0610  69 1013 1750
       NXTG   SRD    0003             FOR Q2         1013  31 0003 1223
              STL   FQ2                              1223  20 0932 0988
              SRD    0001                            0988  31 0001 0695
              STL   Q2                               0695  20 0799 0402
1
              RAU   PHI75            CONVERT         0402  60 0927 0982
              MPY   LNE2              PHI75 TO       0982  19 0888 0660
              LDD   NXTH     ELRGX    MILLIMTRS      0660  69 1063 1750
       NXTH   SRD    0003             FOR Q3         1063  31 0003 1273
              STL   FQ3                              1273  20 1032 1038
              SRD    0001                            1038  31 0001 0745
              STL   Q3                               0745  20 0849 0452
1
              RAU   FQ1              CALC SO         0452  60 0832 1088
              SRT    0003                            1088  30 0003 1147
              DVR   FQ3                              1147  64 1032 0294
1
              LDD   NXTR     SQURT                   0294  69 1197 1701
       NXTR   SRD    0005                            1197  31 0005 1011
              STL   SO                               1011  20 1117 0920
1
              SLT    0004            CALC            0920  35 0004 1082
              LDD   RNXT     LOG10    LOG SO         1082  69 1138 1855
       RNXT   RAL   UPPER                            1138  65 8003 0795
              SRD    0004                            0795  31 0004 1257
              STL   LGSO                             1257  20 1061 0314
1
              RAU   FQ2              CALC SKG        0314  60 0932 1188
              MPY   DISTB                            1188  19 8001 1111
              SRD    0003                            1111  31 0003 1222
              STL   SDN                              1222  20 1132 1238
1
              RAU   FQ1                              1238  60 0832 1288
              MPY   FQ3                              1288  19 1032 0454
              SLT    0005                            0454  35 0005 1167
              DVR   SDN                              1167  64 1132 0344
              LDD   SNXT     SQURT                   0344  69 1247 1701
       SNXT   SRD    0006                            1247  31 0006 1113
              STL   SKG                              1113  20 1217 0970
1
              LDD   CW010            PREPARE TO      0970  69 0991 0394
              STD   P0010             PUNCH          0394  24 0036 0989
1                                     TRASK
              RAL   Q1                VALUES         0989  65 0749 0504
              SLT    0005                            0504  35 0005 1267
              ALO   Q2                               1267  15 0799 0554
              STL   P0006                            0554  20 0032 1338
1
              RAL   Q3                               1338  65 0849 0604
              SLT    0005                            0604  35 0005 1317
              ALO   SO                               1317  15 1117 1272
              STL   P0007                            1272  20 0033 1388
1
              RAL   LGSO                             1388  65 1061 1367
```

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                SLT   0005                              1367  35 0005 1182
                ALO   SKG                               1182  15 1217 1322
                STL   P0008                             1322  20 0034 1039
   1
                LDD   ZEROS                             1039  69 0087 0840
                STD   P0009                             0840  24 0035 1089
   1
                RAL   P0004               SET CARD      1089  65 0030 1139
                SRT    0001                TYPE         1139  30 0001 0845
                SLT    0001                NO. 5        0845  35 0001 0701
                ALO   F1VEE                             0701  15 1378 1234
                STL   P0004                             1234  20 0030 1284
   1
   1
                PCH   P0001               PUNCH CARD    1284  71 0027 1232
   1
                RAL   TEST3               INDICATE      1232  65 0537 0942
                ALO   BD001                TRASK        0942  15 0224 1282
                STL   TEST3       CC2      VALUES       1282  20 0537 0690
                                           FINISHED
   1
   1
   1              CALCULATE INMAN VALUES
   1
        INMAN   RAL   P1CW                              0360  65 1163 0768
                ALO   CW010                             0768  15 0991 0895
                STL   P0010                             0895  20 0036 1189
   1
                RAU   PH116                CALC PHI     1189  60 0627 1332
                AUP   PHI84                MEAN DIAM    1332  10 1027 1382
                MPY   FIVEE                             1382  19 1378 0899
                SRD    0001                             0899  31 0001 1357
                STL   F1MD                              1357  20 1161 0364
   1
                RAU   PHI84               CALC PHI      0364  60 1027 1334
                SUP   PH116                DEVIATION    1334  11 0627 1384
                MPY   F1VEE                MEASURE      1384  19 1378 0949
                SRD    0001                             0949  31 0001 0508
                STL   FIDV                              0508  20 1213 0818
                BM1               CISK                  0818  46 1372 1323
   1
                RAL   CW002                             1372  65 1237 0992
                ALO   P0010                             0992  15 0036 1042
                STL   P0010       CISK                  1042  20 0036 1323
   1
        C1SK    RAU   FIMD                CALC PHI      1323  60 1161 0868
                SUP   PH150                SKEWNESS     0868  11 0827 1239
                SRT    0002                MEASURE      1239  30 0002 0945
                DVR   F1DV                              0945  64 1213 1373
                SRD    0006                             1373  31 0006 1289
                STL   FISK                              1289  20 0444 1297
   1
                RAU   PH195               CALC 2ND      1297  60 1127 1339
                SUP   TSTAA                PHI          1339  11 0156 1211
                NZU               CANT    SKEWNESS      1211  44 0918 0968
                AUP   DISTB                MEASURE      0918  10 8001 0826
                AUP   PHI05                             0826  10 0711 1018
                MPY   F1VEE                             1018  19 1378 0999
                SRD    0001                             0999  31 0001 0558
                SLO   PH150                             0558  16 0827 1389
                RAU   LOWER                             1389  60 8002 1347
                SRT    0002                             1347  30 0002 0654
                DVR   FIDV                              0654  64 1213 0874
                SRD    0006                             0874  31 0006 1092
                STL   F2SK                              1092  20 1397 1150
                BM1               CIKU                  1150  46 0704 0754
   1
                RAL   CW003                             0704  65 1337 1142
                ALO   P0010                             1142  15 0036 1192
                STL   P0010       CIKU                  1192  20 0036 0754
   1
        CIKU    RAU   PHI95               CALC PHI      0754  60 1127 0890
                SUP   PHI05                KURTOSIS     0890  11 0711 1068
                MPY   F1VEE                MEASURE      1068  19 1378 1049
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              SRD   0001                                1049  31 0001 0608
              RAU   LOWER                               0608  60 8002 1118
              SUP   FIDV                                1118  11 1213 1168
              SRT   0002                                1168  30 0002 0876
              DVR   DISTB                               0876  64 8001 0940
              SRD   0006                                0940  31 0006 0658
              STL   FIKU    PCHI                        0658  20 1263 1218
 1
      CANT    LDD   TSTAA                               0968  69 0156 0710
              STD   F2SK                                0710  24 1397 1200
              STD   F1KU    PCHI                        1200  24 1263 1218
 1
      PCHI    RAM   PHI50           PREPARE TO          1218  67 0827 0990
              SLT   0005             PUNCH              0990  35 0005 0804
              AML   F1MD             INMAN              0804  17 1161 1268
              STL   P0006            VALUES             1268  20 0032 1040
 1
              RAM   F1DV                                1040  67 1213 1318
              SLT   0005                                1318  35 0005 1090
              AML   FISK                                1090  17 0444 1099
              STL   P0007                               1099  20 0033 1140
 1
              RAM   F2SK                                1140  67 1397 0751
              SLT   0005                                0751  35 0005 1313
              AML   FIKU                                1313  17 1263 1368
              STL   P0008                               1368  20 0034 1190
 1
              LDD   ZEROS                               1190  69 0087 1240
              STD   P0009                               1240  24 0035 1290
 1
              RAL   FIMD            TEST FOR            1290  65 1161 0419
              BMI   NGJ     PSJ      NEGATIVE           0419  46 0924 0974
      PSJ     RAL   FISK             VALUES             0974  65 0444 1149
              BMI   NGK     PSK                         1149  46 0502 0854
      PSK     RAL   F1KU                                0854  65 1263 0469
              BMI   NGL     PSL                         0469  46 1024 1074
 1
      NGJ     RSL   P0006                               0924  66 0032 1340
              STL   P0006   PSJ                         1340  20 0032 0974
      NGK     RSL   P0007                               0502  66 0033 1390
              STL   P0007   PSK                         1390  20 0033 0854
      NGL     RSL   P0008                               1024  66 0034 1242
              STL   P0008   PSL                         1242  20 0034 1074
 1
      PSL     RAL   P0004           SET CARD            1074  65 0030 1292
              SRT   0001             TYPE               1292  30 0001 1199
              SLT   0001             NO. 6              1199  35 0001 0708
              AML   SIXXX                               0708  17 1157 1261
              STL   P0004                               1261  20 0030 1342
 1
              PCH   P0001           PUNCH CARD          1342  71 0027 1392
 1
              RAL   TEST3           INMAN CALC          1392  65 0537 0494
              ALO   BD002            COMPLETED          0494  15 0274 0544
              STL   TEST3   CC2                         0544  20 0537 0690
 1
 1
 1               CALCULATE FOLK AND WARD
 1               VALUES
 1
      FANDW   LDD   CW010                               0264  69 0991 0594
              STD   P0010                               0594  24 0036 0644
 1
              RAU   PHI16           CALC MZ             0644  60 0627 0694
              AUP   PHI50           MEDIAN              0694  10 0827 0744
              AUP   PH184           DIAMETER            0744  10 1027 0794
 1
              MPY   RCP3                                0844  19 0448 0519
              SRD   0005                                0519  31 0005 0894
              SLT   0005                                0894  35 0005 0758
              BMI   NGMZ                                0758  46 1311 0612
              STL   P0006   CLSD                        0612  20 0032 0944
 1
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      NGMZ   RAM  LOWER                             1311  67 8002 0569
             STL  P0006                             0569  20 0032 0994
             RAL  CW001                             0994  65 0672 1044
             ALO  P0010                             1044  15 0036 1094
             STL  P0010   CLSD                      1094  20 0036 0944
 1
      CLSD   RAU  PH184          CALCULATE          0944  60 1027 1144
             SUP  PH116           STANDARD          1144  11 0627 1194
             MPY  QTR             DEVIATION         1194  19 0498 0619
             SRD   0002                             0619  31 0002 1244
             STL  FST                               1244  20 1249 0552
 1
             RAU  PH195                             0552  60 1127 1294
             SUP  PHI05                             1294  11 0711 0669
             STU  F955                              0669  21 1124 1344
             MPY  RC66                              1344  19 0548 0719
             SRD   0005                             0719  31 0005 1394
             ALO  FST                               1394  15 1249 0904
             SLT   0002                             0904  35 0002 1361
             STL  TLFA                              1361  20 0769 1174
             SLT   0003                             1174  35 0003 0995
             STL  P0007                             0995  20 0033 1045
 1
             BM1          CLSK                      1045  46 0598 1299
             RAM  LOWER                             0598  67 8002 0808
             STL  P0007                             0808  20 0033 1095
             RAL  CW002                             1095  65 1237 1145
             ALO  P0010                             1145  15 0036 1195
             STL  P0010   CLSK                      1195  20 0036 1299
 1
      CLSK   RAU  FISK           CALCULATE          1299  60 0444 1349
             MPY  FIVEE          SKEWNESS           1349  19 1378 1399
             SRD   0001                             1399  31 0001 0858
 1
             STL  SKT                               0858  20 1363 0819
             RAU  PHI95                             0819  60 1127 1245
             SUP  PHI05                             1245  11 0711 0869
             AUP  UPPER                             0869  10 8003 1295
             SRT   0004                             1295  30 0004 0908
             STL  DN2                               0908  20 0414 0919
 1
             RAU  PH105                             0919  60 0711 0969
             AUP  PH195                             0969  10 1127 1345
             SUP  PHI50                             1345  11 0827 1395
             SUP  DISTB                             1395  11 8001 0954
             DVR  DN2                               0954  64 0414 0926
             SRD   0002                             0926  31 0002 0546
             ALO  SKT                               0546  15 1363 1019
             SLT   0005                             1019  35 0005 0596
             STL  P0008                             0596  20 0034 0646
             SRT   0002          ADD 12 TO          0646  30 0002 1004
             ALO  TWELV          SKEWNESS           1004  15 0958 0464
             STL  TLFB           FOR TLU            0464  20 1069 1224
 1
             RAL  P0008                             1224  65 0034 0696
             BM1          CLKG                      0696  46 1250 1300
 1
             RAM  P0008                             1250  67 0034 0746
             STL  P0008                             0746  20 0034 0796
             RAL  CW003                             0796  65 1337 0846
             ALO  P0010                             0846  15 0036 0896
             STL  P0010   CLKG                      0896  20 0036 1300
 1
      CLKG   RAU  PH175          CALCULATE          1300  60 0927 0946
             SUP  PHI25           KURTOSIS          0946  11 0727 0996
             MPY  C244                              0996  19 1350 1274
             STL  DN                                1274  20 1046 0801
 1
             RAU  F955                              0801  60 1124 1096
             DVR  DN                                1096  64 1046 1008
             SRD   0006                             1008  31 0006 0976
             SLT   0005                             0976  35 0005 1146
             STL  P0009                             1146  20 0035 1196
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               SLT   0001                         1196  35 0001 1054
               STL   TLFC                         1054  20 0760 0514
     1
               8MI   NGKG    TLUF                 0514  46 1119 1169
     1
        NGKG   RAM   P0009                        1119  67 0035 1246
               STL   P0009                        1246  20 0035 1296
     1
               RAL   CW004                        1296  65 1387 1346
               ALO   P0010                        1346  15 0036 1396
               STL   P0010   TLUF                 1396  20 0036 1169
     1
        TLUF   RAL   NXFA            USE TLU      1169  65 1324 0648
               LDD   TLFA            FOR CODING   0648  69 0769 1374
               TLU   D0001   LOWER   STANDARD     1374  84 1650 8002
        NXFA   RAU   D0001           DEVIATION    1324  60 1650 1058
               SLT    0009                        1058  35 0009 0698
               SRT    0009                        0698  30 0009 1219
               AUP   P0007                        1219  10 0033 0748
               STU   P0007                        0748  21 0033 0798
     1
               RAL   NXFB            SKEWNESS     0798  65 0851 1108
               LDD   TLFB                         1108  69 1069 1026
               TLU   D0001   LOWER                1026  84 1650 8002
        NXF8   RAU   D0001                        0851  60 1650 1158
               SLT    0009                        1158  35 0009 0848
               SRT    0009                        0848  30 0009 1269
               AUP   P0008                        1269  10 0034 0898
               STU   P0008                        0898  21 0034 0948
     1
               RAL   NXFC            KURTOSIS     0948  65 0901 1208
               LDD   TLFC                         1208  69 0760 0564
               TLU   D0001   LOWER                0564  84 1650 8002
        NXFC   RAU   D0001                        0901  60 1650 1258
               SLT    0009                        1258  35 0009 0998
               SRT    0009                        0998  30 0009 1319
               AUP   P0009                        1319  10 0035 1048
               STU   P0009                        1048  21 0035 1098
     1
               RAL   P0004           SET CARD     1098  65 0030 1148
               SRT    0001            TYPE        1148  30 0001 1308
               SLT    0001            NO. 7       1308  35 0001 1369
               ALO   SEVEN                        1369  15 0384 1198
               STL   P0004                        1198  20 0030 1248
     1
               PCH   P0001           PUNCH CARD   1248  71 0027 1298
     1
               RAL   TEST3           FANDW        1298  65 0537 1348
               ALO   BD003            VALUES      1348  15 0324 1398
               STL   TEST3   CC2      FINISHED    1398  20 0537 0690
     1
     1            INITIALIZING 8LOCK
     1
        1NITL  RAL   TSTAA           SET ALL      0011  65 0156 0662
               AUP   1NAA    UPPER    CELLS IN    0662  10 1020 8003
        1NAA   STL   C0050   INA8     REGIONS     1020  20 1649 0602
        INAB   SUP   DA001            A, 8, C     0602  11 0016 1076
               SUP   IN8              TO 99999    1076  11 0951 1358
               8M1   INOT                         1358  46 0712 0762
               AUP   DIST8   UPPER                0762  10 8001 8003
        INB    STL   A0001   INA8                 0951  20 1500 0602
     1
        INOT   LDD   ORGA1                        0712  69 0750 1104
               STD   AA111                        1104  24 0143 1001
     1
               LDD   ORGA2                        1001  69 0800 1154
               STD   AA222                        1154  24 0115 1070
     1
               LDD   ORGOT                        1070  69 0850 1204
               STD   TTOUT                        1204  24 0407 0810
     1
               LDD   ATESS                        0810  69 0153 0860
               STD   TEST1                        0860  24 0167 1120
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                    STD   TEST3                   1120  24 0537 1051
       1
                    LDD   ZEROS                   1051  69 0087 1101
                    STD   PICW                    1101  24 1163 1170
                    STD   SUMMP                   1170  24 0111 0614
                    STD   P0006                   0614  24 0032 1151
                    STD   P0007                   1151  24 0033 1201
                    STD   P0008                   1201  24 0034 1251
                    STD   P0009                   1251  24 0035 1301
                    STD   A0001                   1301  24 1500 1254
                    STD   B0001                   1254  24 1550 1304
                    STD   TEST6                   1304  24 1059 0812
                    STD   TEST7                   0812  24 0449 0652
                    STD   CRDCT                   0652  24 0186 1351
       1
                    LDD   TSTAA                   1351  69 0156 0910
                    STD   PHI05                   0910  24 0711 0664
                    STD   PHI16                   0664  24 0627 0702
                    STD   PHI25                   0702  24 0727 0752
                    STD   PHI50                   0752  24 0827 0802
                    STD   PHI75                   0802  24 0927 0852
                    STD   PHI84                   0852  24 1027 0902
                    STD   PHI95                   0902  24 1127 0952
       1
                    LDD   FOURR                   0952  69 0094 1002
                    STD   TEST4                   1002  24 0586 1052
       1
                    LDD   ORGM1                   1052  69 0296 1102
                    STD   M0001                   1102  24 1681 1152
       1
                    LDD   ORGM2                   1152  69 0787 1202
                    STD   M0002                   1202  24 1682 1252
       1
                    LDD   CW010                   1252  69 0991 1302
                    STD   P0010   DATA1           1302  24 0036 0050
       1
       1              TABLE OF CONSTANTS
       1
           DA001    00    0001    0000            0016  00 0001 0000
           DA002    00    0002    0000            0132  00 0002 0000
           DA010    00    0010    0000            0388  00 0010 0000
           DA050    00    0050    0000            0116  00 0050 0000
           DA100    00    0100    0000            1080  00 0100 0000
           DI104    00    0001    0004            0182  00 0001 0004
           DA551    00    1551    0000            0090  00 1551 0000
       1
           INCDA    00    0001    0000            0250  00 0001 0000
           CDATT    00    0001    0021            0232  00 0001 0021
       1
           BD001    00    0000    0001            0224  00 0000 0001
           BD002    00    0000    0010            0274  00 0000 0010
           BD003    00    0000    0100            0324  00 0000 0100
           BD004    00    0000    1000            0374  00 0000 1000
           BD005    00    0001    0000            0424  00 0001 0000
           BD006    00    0010    0000            0474  00 0010 0000
           BD007    00    0100    0000            0524  00 0100 0000
       1
           PC005    00    0000    0500            0118  00 0000 0500
           PC016    00    0000    1600            0218  00 0000 1600
           PC020    00    0000    2000            0595  00 0000 2000
           PC025    00    0000    2500            0318  00 0000 2500
           PC050    00    0000    5000            0286  00 0000 5000
           PC072    00    0000    7200            0178  00 0000 7200
           PC075    00    0000    7500            0468  00 0000 7500
           PC081    00    0000    8100            0228  00 0000 8100
           PC084    00    0000    8400            0518  00 0000 8400
           PC092    00    0000    9200            0278  00 0000 9200
           PC095    00    0000    9500            0618  00 0000 9500
           PC100    00    0001    0000            0018  00 0001 0000
       1
         - TT005    00    0000    1645            0256  00 0000 1645
         - TT016    00    0000    0995            0306  00 0000 0995
         - TT025    00    0000    0674            0356  00 0000 0674
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```
     TT050   00   0000  0000                  0406  00 0000 0000
     TT075   00   0000  0674                  0456  00 0000 0674
     TT084   00   0000  0995                  0506  00 0000 0995
     TT095   00   0000  1645                  0556  00 0000 1645
1
     PHI-1   00   0000  0900                  0545  00 0000 0900
     PHI4    00   0000  1400                  0445  00 0000 1400
     PHI8    00   0000  1800                  1236  00 0000 1800
     PHI10   00   0000  1000                  0038  00 0000 1000
1
     ZEROS   00   0000  0000                  0087  00 0000 0000
     ONEEE   00   0000  0001                  0130  00 0000 0001
     TWOOO   00   0000  0002                  0024  00 0000 0002
     THREE   00   0000  0003                  0288  00 0000 0003
     FOURR   00   0000  0004                  0094  00 0000 0004
     FIVEE   00   0000  0005                  1378  00 0000 0005
     SIXXX   00   0000  0006                  1157  00 0000 0006
     SEVEN   00   0000  0007                  0384  00 0000 0007
     EIGHT   00   0000  0008                  0532  00 0000 0008
     NINEE   00   0000  0009                  0776  00 0000 0009
     TENNN   00   0000  0010                  0582  00 0000 0010
     TWELV   00   0120  0000                  0958  00 0120 0000
     TWNTY   00   0000  0020                  0412  00 0000 0020
     4.090   00   0000  4090                  0088  00 0000 4090
1
     CW001   00   0008  0000                  0672  00 0008 0000
     CW002   00   0000  8000                  1237  00 0000 8000
     CW003   00   0000  0800                  1337  00 0000 0800
     CW004   00   0000  0080                  1387  00 0000 0080
     CW010   00   0000  0008                  0991  00 0000 0008
1
     ATESS   88   8888  8888                  0153  88 8888 8888
1
   - LNE2    00   0693  1472                  0888  00 0693 1472
1
     TSTAA   00   0009  9999                  0156  00 0009 9999
1
     CONE    00   0100  0000                  0410  00 0100 0000
1
     RCP3    00   0003  3333                  0448  00 0003 3333
     RC66    00   0001  5152                  0548  00 0001 5152
1
     QTR     00   0000  0025                  0498  00 0000 0025
     C244    00   0000  0244                  1350  00 0000 0244
1
     N92     00   0000  0200                  0726  00 0000 0200
1
             SEQ  D0001
     *       00   0000  0000  CONSTANTS       1650  00 0000 0000
     *       00   0000  3501  FOR TLU         1651  00 0000 3501
     *       00   0000  5002  OF F AND W      1652  00 0000 5002
     *       00   0001  0003  SORTING         1653  00 0001 0003
     *       00   0002  0004                  1654  00 0002 0004
     *       00   0004  0005                  1655  00 0004 0005
     *       00   0009  9996                  1656  00 0009 9996
1
     *       00   0090  0000  CONSTANTS       1657  00 0090 0000
     *       00   0100  0000  FOR TLU         1658  00 0100 0000
     *       00   0117  0001  F AND W         1659  00 0117 0001
     *       00   0119  0002  SKEWNESS        1660  00 0119 0002
     *       00   0121  0003                  1661  00 0121 0003
     *       00   0123  0004                  1662  00 0123 0004
     *       00   2222  0005                  1663  00 2222 0005
1
     *       00   9000  0001  CONSTANTS       1664  00 9000 0001
     *       01   1100  0002  FOR TLU         1665  01 1100 0002
     *       01   5000  0003  OF F AND W      1666  01 5000 0003
     *       03   0000  0004  KURTOSIS        1667  03 0000 0004
     *       99   9999  9995                  1668  99 9999 9995
1
1
             SEQ  T0001
1
```

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1674 | * | 00 | 0000 | 0000 | TABLE OF | 1400 | 00 | 0000 | 0000 |
| 1675 | * | 00 | 0000 | 0000 | T-VALUES | 1401 | 00 | 0000 | 0000 |
| 1676 | * | 00 | 0120 | 0030 | | 1402 | 00 | 0120 | 0030 |
| 1677 | * | 00 | 2390 | 0060 | | 1403 | 00 | 2390 | 0060 |
| 1678 | * | 00 | 3590 | 0090 | | 1404 | 00 | 3590 | 0090 |
| 1679 | * | 00 | 4780 | 0120 | DIGITS IN | 1405 | 00 | 4780 | 0120 |
| 1680 | * | 00 | 5960 | 0150 | OP AND DA | 1406 | 00 | 5960 | 0150 |
| 1681 | * | 00 | 7140 | 0180 | POSITIONS | 1407 | 00 | 7140 | 0180 |
| 1682 | * | 00 | 8320 | 0210 | ARE | 1408 | 00 | 8320 | 0210 |
| 1683 | * | 00 | 9480 | 0240 | PERCENTS, | 1409 | 00 | 9480 | 0240 |
| 1684 | * | 01 | 0640 | 0270 | VALUES IN | 1410 | 01 | 0640 | 0270 |
| 1685 | * | 01 | 1790 | 0300 | IA ARE | 1411 | 01 | 1790 | 0300 |
| 1686 | * | 01 | 2930 | 0330 | T-VALUES | 1412 | 01 | 2930 | 0330 |
| 1687 | * | 01 | 4060 | 0360 | | 1413 | 01 | 4060 | 0360 |
| 1688 | * | 01 | 5170 | 0390 | | 1414 | 01 | 5170 | 0390 |
| 1689 | * | 01 | 6280 | 0420 | | 1415 | 01 | 6280 | 0420 |
| 1690 | * | 01 | 7360 | 0450 | | 1416 | 01 | 7360 | 0450 |
| 1691 | * | 01 | 8440 | 0480 | | 1417 | 01 | 8440 | 0480 |
| 1692 | * | 01 | 9500 | 0510 | | 1418 | 01 | 9500 | 0510 |
| 1693 | * | 02 | 0540 | 0540 | | 1419 | 02 | 0540 | 0540 |
| 1694 | * | 02 | 1570 | 0570 | | 1420 | 02 | 1570 | 0570 |
| 1695 | * | 02 | 2570 | 0600 | | 1421 | 02 | 2570 | 0600 |
| 1696 | * | 02 | 3570 | 0630 | | 1422 | 02 | 3570 | 0630 |
| 1697 | * | 02 | 4540 | 0660 | | 1423 | 02 | 4540 | 0660 |
| 1698 | * | 02 | 5490 | 0690 | | 1424 | 02 | 5490 | 0690 |
| 1699 | * | 02 | 6420 | 0720 | | 1425 | 02 | 6420 | 0720 |
| 1700 | * | 02 | 7340 | 0750 | | 1426 | 02 | 7340 | 0750 |
| 1701 | * | 02 | 8230 | 0780 | | 1427 | 02 | 8230 | 0780 |
| 1702 | * | 02 | 9100 | 0810 | | 1428 | 02 | 9100 | 0810 |
| 1703 | * | 02 | 9950 | 0840 | | 1429 | 02 | 9950 | 0840 |
| 1704 | * | 03 | 0780 | 0870 | | 1430 | 03 | 0780 | 0870 |
| 1705 | * | 03 | 1590 | 0900 | | 1431 | 03 | 1590 | 0900 |
| 1706 | * | 03 | 2380 | 0930 | | 1432 | 03 | 2380 | 0930 |
| 1707 | * | 03 | 3150 | 0960 | | 1433 | 03 | 3150 | 0960 |
| 1708 | * | 03 | 3890 | 0990 | | 1434 | 03 | 3890 | 0990 |
| 1709 | * | 03 | 4610 | 1020 | | 1435 | 03 | 4610 | 1020 |
| 1710 | * | 03 | 5310 | 1050 | | 1436 | 03 | 5310 | 1050 |
| 1711 | * | 03 | 5990 | 1080 | | 1437 | 03 | 5990 | 1080 |
| 1712 | * | 03 | 6650 | 1110 | | 1438 | 03 | 6650 | 1110 |
| 1713 | * | 03 | 7290 | 1140 | | 1439 | 03 | 7290 | 1140 |
| 1714 | * | 03 | 7900 | 1170 | | 1440 | 03 | 7900 | 1170 |
| 1715 | * | 03 | 8490 | 1200 | | 1441 | 03 | 8490 | 1200 |
| 1716 | * | 03 | 9070 | 1230 | | 1442 | 03 | 9070 | 1230 |
| 1717 | * | 03 | 9620 | 1260 | | 1443 | 03 | 9620 | 1260 |
| 1718 | * | 04 | 0150 | 1290 | | 1444 | 04 | 0150 | 1290 |
| 1719 | * | 04 | 0660 | 1320 | | 1445 | 04 | 0660 | 1320 |
| 1720 | * | 04 | 1150 | 1350 | | 1446 | 04 | 1150 | 1350 |
| 1721 | * | 04 | 1620 | 1380 | | 1447 | 04 | 1620 | 1380 |
| 1722 | * | 00 | 0000 | 0000 | SPACER | 1448 | 00 | 0000 | 0000 |
| 1723 | * | 00 | 0000 | 0000 | SPACER | 1449 | 00 | 0000 | 0000 |
| 1724 | * | 04 | 2070 | 1410 | | 1450 | 04 | 2070 | 1410 |
| 1725 | * | 04 | 2510 | 1440 | | 1451 | 04 | 2510 | 1440 |
| 1726 | * | 04 | 2920 | 1470 | | 1452 | 04 | 2920 | 1470 |
| 1727 | * | 04 | 3320 | 1500 | | 1453 | 04 | 3320 | 1500 |
| 1728 | * | 04 | 3700 | 1530 | | 1454 | 04 | 3700 | 1530 |
| 1729 | * | 04 | 4060 | 1560 | | 1455 | 04 | 4060 | 1560 |
| 1730 | * | 04 | 4410 | 1590 | | 1456 | 04 | 4410 | 1590 |
| 1731 | * | 04 | 4740 | 1620 | | 1457 | 04 | 4740 | 1620 |
| 1732 | * | 04 | 5050 | 1650 | | 1458 | 04 | 5050 | 1650 |
| 1733 | * | 04 | 5350 | 1680 | | 1459 | 04 | 5350 | 1680 |
| 1734 | * | 04 | 5640 | 1710 | | 1460 | 04 | 5640 | 1710 |
| 1735 | * | 04 | 5910 | 1740 | | 1461 | 04 | 5910 | 1740 |
| 1736 | * | 04 | 6160 | 1770 | | 1462 | 04 | 6160 | 1770 |
| 1737 | * | 04 | 6410 | 1800 | | 1463 | 04 | 6410 | 1800 |
| 1738 | * | 04 | 6640 | 1830 | | 1464 | 04 | 6640 | 1830 |
| 1739 | * | 04 | 6860 | 1860 | | 1465 | 04 | 6860 | 1860 |
| 1740 | * | 04 | 7060 | 1890 | | 1466 | 04 | 7060 | 1890 |
| 1741 | * | 04 | 7260 | 1920 | | 1467 | 04 | 7260 | 1920 |
| 1742 | * | 04 | 7440 | 1950 | | 1468 | 04 | 7440 | 1950 |
| 1743 | * | 04 | 7610 | 1980 | | 1469 | 04 | 7610 | 1980 |
| 1744 | * | 04 | 7780 | 2010 | | 1470 | 04 | 7780 | 2010 |
| 1745 | * | 04 | 7930 | 2040 | | 1471 | 04 | 7930 | 2040 |
| 1746 | * | 04 | 8080 | 2070 | | 1472 | 04 | 8080 | 2070 |

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1747          *     04    8210    2100
1748          *     04    8340    2130
1749          *     04    8460    2160
1750          *     04    8570    2190
1751          *     04    8680    2220
1752          *     04    8780    2250
1753          *     04    8870    2280
1754          *     04    8960    2310
1755          *     04    9040    2340
1756          *     04    9110    2370
1757          *     04    9200    2410
1758          *     04    9310    2460
1759          *     04    9400    2510
1760          *     04    9600    2650
1761          *     04    9700    2750
1762          *     04    9800    2880
1763          *     04    9900    3080
1764          *     05    0000    4090
1765     1
1766     1
1767                PAT
1768                PST
1769                END   START
```

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1473   04 8210  2100
1474   04 8340  2130
1475   04 8460  2160
1476   04 8570  2190
1477   04 8680  2220
1478   04 8780  2250
1479   04 8870  2280
1480   04 8960  2310
1481   04 9040  2340
1482   04 9110  2370
1483   04 9200  2410
1484   04 9310  2460
1485   04 9400  2510
1486   04 9600  2650
1487   04 9700  2750
1488   04 9800  2880
1489   04 9900  3080
1490   05 0000  4090
```

APPENDIX 4 <u>Listing of Sediment Description Program (# 0213) for IBM 709 Computer</u>

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C     PROGRAM FOR COMPUTING STATISTICS ON MARINE SEDIMENTS                SDP-0001
C     ROUTINE  0213  FOR THE IBM 709 COMPUTER                             SDP-0002
C     PREPARED BY  E. E. COLLIAS AND M. R. RONA                           SDP-0003
C     DECEMBER 20  1960                                                   SDP-0004
C                                                                         SDP-0005
      DIMENSION PHI(100), FRWT(100), PRCT(100), FRPC(100), ACPC(100),     SDP-0006
     1T(100), TBLPC(100), TBLT(100), TLFD(20),ITLFDC(20), TLFS(20),       SDP-0007
     2ITLFSC(20),TLFK(20),ITLFKC(20), PHIMA(20), PHIMB(20), CRMC(20),     SDP-0008
     3STMC(20), EXMC(20), CRMB(20), STMP(20), EXMB(20), CRMT(20),         SDP-0009
     4STMB(20), STAC(20), MA(30), MAT(30), MB(30), MBT(30), MC(30)        SDP-0010
C                                                                         SDP-0011
C     TABLE OF PERCENTS FOR TABLE (TBLPC)                                 SDP-0012
C                                                                         SDP-0013
      TBLPC (01) = 00.00                                                  SDP-0014
      TBLPC (02) = 01.20                                                  SDP-0015
      TBLPC (03) = 03.59                                                  SDP-0016
      TBLPC (04) = 04.78                                                  SDP-0017
      TBLPC (05) = 05.96                                                  SDP-0018
      TBLPC (06) = 07.14                                                  SDP-0019
      TBLPC (07) = 08.32                                                  SDP-0020
      TBLPC (08) = 09.48                                                  SDP-0021
      TBLPC (09) = 10.64                                                  SDP-0022
      TBLPC (10) = 11.79                                                  SDP-0023
      TBLPC (11) = 12.93                                                  SDP-0024
      TBLPC (12) = 14.60                                                  SDP-0025
      TBLPC (13) = 15.17                                                  SDP-0026
      TBLPC (14) = 16.28                                                  SDP-0027
      TBLPC (15) = 17.36                                                  SDP-0028
      TBLPC (16) = 18.44                                                  SDP-0029
      TBLPC (17) = 19.50                                                  SDP-0030
      TBLPC (18) = 20.54                                                  SDP-0031
      TBLPC (19) = 21.57                                                  SDP-0032
      TBLPC (20) = 22.57                                                  SDP-0033
      TBLPC (21) = 23.57                                                  SDP-0034
      TBLPC (22) = 24.54                                                  SDP-0035
      TBLPC (23) = 25.49                                                  SDP-0036
      TBLPC (24) = 26.42                                                  SDP-0037
      TBLPC (25) = 27.34                                                  SDP-0038
      TBLPC (26) = 28.23                                                  SDP-0039
      TBLPC (27) = 29.10                                                  SDP-0040
      TBLPC (28) = 29.95                                                  SDP-0041
      TBLPC (29) = 30.78                                                  SDP-0042
      TBLPC (30) = 31.59                                                  SDP-0043
      TBLPC (31) = 32.38                                                  SDP-0044
      TBLPC (32) = 33.15                                                  SDP-0045
      TBLPC (33) = 33.89                                                  SDP-0046
      TBLPC (34) = 34.61                                                  SDP-0047
      TBLPC (35) = 35.31                                                  SDP-0048
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      TBLPC (36) = 35.99                                                SDP-0049
      TBLPC (37) = 36.65                                                SDP-0050
      TBLPC (38) = 37.29                                                SDP-0051
      TBLPC (39) = 37.90                                                SDP-0052
      TBLPC (40) = 38.49                                                SDP-0053
      TBLPC (41) = 39.07                                                SDP-0054
      TBLPC (42) = 39.62                                                SDP-0055
      TBLPC (43) = 40.15                                                SDP-0056
      TBLPC (44) = 40.66                                                SDP-0057
      TBLPC (45) = 41.15                                                SDP-0058
      TBLPC (46) = 41.62                                                SDP-0059
      TBLPC (47) = 42.07                                                SDP-0060
      TBLPC (48) = 42.51                                                SDP-0061
      TBLPC (49) = 42.92                                                SDP-0062
      TBLPC (50) = 43.20                                                SDP-0063
      TBLPC (51) = 43.70                                                SDP-0064
      TBLPC (52) = 44.06                                                SDP-0065
      TBLPC (53) = 44.10                                                SDP-0066
      TBLPC (54) = 44.74                                                SDP-0067
      TBLPC (55) = 45.05                                                SDP-0068
      TBLPC (56) = 45.35                                                SDP-0069
      TBLPC (57) = 45.64                                                SDP-0070
      TBLPC (58) = 45.91                                                SDP-0071
      TBLPC (59) = 46.16                                                SDP-0072
      TBLPC (60) = 46.41                                                SDP-0073
      TBLPC (61) = 46.64                                                SDP-0074
      TBLPC (62) = 46.86                                                SDP-0075
      TBLPC (63) = 47.06                                                SDP-0076
      TBLPC (64) = 47.26                                                SDP-0077
      TBLPC (65) = 47.44                                                SDP-0078
      TBLPC (66) = 47.61                                                SDP-0079
      TBLPC (67) = 47.78                                                SDP-0080
      TBLPC (68) = 47.93                                                SDP-0081
      TBLPC (69) = 48.08                                                SDP-0082
      TBLPC (70) = 48.21                                                SDP-0083
      TBLPC (71) = 48.34                                                SDP-0084
      TBLPC (72) = 48.46                                                SDP-0085
      TBLPC (73) = 48.57                                                SDP-0086
      TBLPC (74) = 48.68                                                SDP-0087
      TBLPC (75) = 48.78                                                SDP-0088
      TBLPC (76) = 48.87                                                SDP-0089
      TBLPC (77) = 48.96                                                SDP-0090
      TBLPC (78) = 49.04                                                SDP-0091
      TBLPC (79) = 49.11                                                SDP-0092
      TBLPC (80) = 49.20                                                SDP-0093
      TBLPC (81) = 49.31                                                SDP-0094
      TBLPC (82) = 49.40                                                SDP-0095
      TBLPC (83) = 49.60                                                SDP-0096
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      TBLPC (84) = 49.70                                                SDP-0097
      TBLPC (85) = 49.80                                                SDP-0098
      TBLPC (86) = 49.90                                                SDP-0099
      TBLPC (87) = 50.00                                                SDP-0100
C                                                                       SDP-0101
C                                                                       SDP-0102
      TBLT  (01) =  0.000                                               SDP-0103
      TBLT  (02) =  0.030                                               SDP-0104
      TBLT  (03) =  0.090                                               SDP-0105
      TBLT  (04) =  0.120                                               SDP-0106
      TBLT  (05) =  0.150                                               SDP-0107
      TBLT  (06) =  0.180                                               SDP-0108
      TBLT  (07) =  0.210                                               SDP-0109
      TBLT  (08) =  0.240                                               SDP-0110
      TBLT  (09) =  0.270                                               SDP-0111
      TBLT  (10) =  0.300                                               SDP-0112
      TBLT  (11) =  0.330                                               SDP-0113
      TBLT  (12) =  0.360                                               SDP-0114
      TBLT  (13) =  0.390                                               SDP-0115
      TBLT  (14) =  0.420                                               SDP-0116
      TBLT  (15) =  0.450                                               SDP-0117
      TBLT  (16) =  0.480                                               SDP-0118
      TBLT  (17) =  0.510                                               SDP-0119
      TBLT  (18) =  0.540                                               SDP-0120
      TBLT  (19) =  0.570                                               SDP-0121
      TBLT  (20) =  0.600                                               SDP-0122
      TBLT  (21) =  0.630                                               SDP-0123
      TBLT  (22) =  0.660                                               SDP-0124
      TBLT  (23) =  0.690                                               SDP-0125
      TBLT  (24) =  0.720                                               SDP-0126
      TBLT  (25) =  0.750                                               SDP-0127
      TBLT  (26) =  0.780                                               SDP-0128
      TBLT  (27) =  0.810                                               SDP-0129
      TBLT  (28) =  0.840                                               SDP-0130
      TBLT  (29) =  0.870                                               SDP-0131
      TBLT  (30) =  0.900                                               SDP-0132
      TBLT  (31) =  0.930                                               SDP-0133
      TBLT  (32) =  0.960                                               SDP-0134
      TBLT  (33) =  0.990                                               SDP-0135
      TBLT  (34) =  1.020                                               SDP-0136
      TBLT  (35) =  1.050                                               SDP-0137
      TBLT  (36) =  1.080                                               SDP-0138
      TBLT  (37) =  1.110                                               SDP-0139
      TBLT  (38) =  1.140                                               SDP-0140
      TBLT  (39) =  1.170                                               SDP-0141
      TBLT  (40) =  1.200                                               SDP-0142
      TBLT  (41) =  1.230                                               SDP-0143
      TBLT  (42) =  1.260                                               SDP-0144
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      TBLT  (43) =  1.290                                           SDP-0145
      TBLT  (44) =  1.320                                           SDP-0146
      TBLT  (45) =  1.350                                           SDP-0147
      TBLT  (46) =  1.380                                           SDP-0148
      TBLT  (47) =  1.410                                           SDP-0149
      TBLT  (48) =  1.440                                           SDP-0150
      TBLT  (49) =  1.470                                           SDP-0151
      TBLT  (50) =  1.500                                           SDP-0152
      TBLT  (51) =  1.530                                           SDP-0153
      TBLT  (52) =  1.560                                           SDP-0154
      TBLT  (53) =  1.590                                           SDP-0155
      TBLT  (54) =  1.620                                           SDP-0156
      TBLT  (55) =  1.650                                           SDP-0157
      TBLT  (56) =  1.680                                           SDP-0158
      TBLT  (57) =  1.710                                           SDP-0159
      TBLT  (58) =  1.740                                           SDP-0160
      TBLT  (59) =  1.770                                           SDP-0161
      TBLT  (60) =  1.800                                           SDP-0162
      TBLT  (61) =  1.830                                           SDP-0163
      TBLT  (62) =  1.860                                           SDP-0164
      TBLT  (63) =  1.890                                           SDP-0165
      TBLT  (64) =  1.920                                           SDP-0166
      TBLT  (65) =  1.950                                           SDP-0167
      TBLT  (66) =  1.980                                           SDP-0168
      TBLT  (67) =  2.010                                           SDP-0169
      TBLT  (68) =  2.040                                           SDP-0170
      TBLT  (69) =  2.070                                           SDP-0171
      TBLT  (70) =  2.100                                           SDP-0172
      TBLT  (71) =  2.130                                           SDP-0173
      TBLT  (72) =  2.160                                           SDP-0174
      TBLT  (73) =  2.190                                           SDP-0175
      TBLT  (74) =  2.220                                           SDP-0176
      TBLT  (75) =  2.250                                           SDP-0177
      TBLT  (76) =  2.280                                           SDP-0178
      TBLT  (77) =  2.310                                           SDP-0179
      TBLT  (78) =  2.340                                           SDP-0180
      TBLT  (79) =  2.370                                           SDP-0181
      TBLT  (80) =  2.410                                           SDP-0182
      TBLT  (81) =  2.460                                           SDP-0183
      TBLT  (82) =  2.510                                           SDP-0184
      TBLT  (83) =  2.650                                           SDP-0185
      TBLT  (84) =  2.750                                           SDP-0186
      TBLT  (85) =  2.880                                           SDP-0187
      TBLT  (86) =  3.080                                           SDP-0188
      TBLT  (87) =  4.090                                           SDP-0189
C                                                                   SDP-0190
C     TABLE FOR FOLK AND WARD CONSTANTS                             SDP-0191
C                                                                   SDP-0192
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```
      TLFD  (01) = 00.00                                  SDP-0193
      TLFD  (02) = 00.35                                  SDP-0194
      TLFD  (03) = 00.50                                  SDP-0195
      TLFD  (04) = 01.00                                  SDP-0196
      TLFD  (05) = 02.00                                  SDP-0197
      TLFD  (06) = 04.00                                  SDP-0198
      TLFD  (07) = 99.99                                  SDP-0199
C                                                         SDP-0200
      ITLFDC(01) = 0                                      SDP-0201
      ITLFDC(02) = 1                                      SDP-0202
      ITLFDC(03) = 2                                      SDP-0203
      ITLFDC(04) = 3                                      SDP-0204
      ITLFDC(05) = 4                                      SDP-0205
      ITLFDC(06) = 5                                      SDP-0206
      ITLFDC(07) = 6                                      SDP-0207
C                                                         SDP-0208
C                                                         SDP-0209
      TLFS  (01) = -3.00                                  SDP-0210
      TLFS  (02) = -0.30                                  SDP-0211
      TLFS  (03) = -0.10                                  SDP-0212
      TLFS  (04) =  0.10                                  SDP-0213
      TLFS  (05) =  0.30                                  SDP-0214
      TLFS  (06) =  9.99                                  SDP-0215
C                                                         SDP-0216
C                                                         SDP-0217
      ITLFSC(01) = 1                                      SDP-0218
      ITLFSC(02) = 1                                      SDP-0219
      ITLFSC(03) = 2                                      SDP-0220
      ITLFSC(04) = 3                                      SDP-0221
      ITLFSC(05) = 4                                      SDP-0222
      ITLFSC(06) = 5                                      SDP-0223
C                                                         SDP-0224
C                                                         SDP-0225
      TLFK  (01) = 00.00                                  SDP-0226
      TLFK  (02) =  0.90                                  SDP-0227
      TLFK  (03) =  1.11                                  SDP-0228
      TLFK  (04) =  1.50                                  SDP-0229
      TLFK  (05) =  3.00                                  SDP-0230
      TLFK  (06) = 99.99                                  SDP-0231
C                                                         SDP-0232
C                                                         SDP-0233
      ITLFKC(01) = 0                                      SDP-0234
      ITLFKC(02) = 1                                      SDP-0235
      ITLFKC(03) = 2                                      SDP-0236
      ITLFKC(04) = 3                                      SDP-0237
      ITLFKC(05) = 4                                      SDP-0238
      ITLFKC(06) = 5                                      SDP-0239
C                                                         SDP-0240
```

```
C     END OF TABLES                                                     SDP-0241
C                                                                       SDP-0242
      ITR = 5                                                           SDP-0243
      ITW = 6                                                           SDP-0244
      TO = TIMEF(X)                                                     SDP-0245
C                                                                       SDP-0246
      KKK = 0                                                           SDP-0247
      MAT = 0                                                           SDP-0248
      MBT = 0                                                           SDP-0249
      MED = 0                                                           SDP-0250
      KSM = 0                                                           SDP-0251
C                                                                       SDP-0252
      ASSIGN 35 TO NC                                                   SDP-0253
      GO TO 900                                                         SDP-0254
C                                                                       SDP-0255
 1    READ INPUT TAPE ITR, 850, CRUZR, STATR, SMPLR, EXID, MO, DA, YR,  SDP-0256
     1LATA, LATB, LATC, LNGA, LNGB, LNGC, IQUD, ITYP, DEPTHR, PHIR,     SDP-0257
     2PRCTR, FRWTR, PAWTR, FRTH, PATH, CRLN, END                        SDP-0258
C                                                                       SDP-0259
C                                                                       SDP-0260
      FRWTR = FRWTR + (FRTH * 100.)                                     SDP-0261
      PAWTR = PAWTR + (PATH * 100.)                                     SDP-0262
      PHIR = (BTSNUF (PHIR)) * .001                                     SDP-0263
C                                                                       SDP-0264
 2    GO TO NA, (4,30)                                                  SDP-0265
 4    IF (ITYP) 5, 5, 6                                                 SDP-0266
 5    ASSIGN 1 TO NB                                                    SDP-0267
      ASSIGN 30 TO NA                                                   SDP-0268
      GO TO 7                                                           SDP-0269
 6    ASSIGN 35 TO NB                                                   SDP-0270
      ASSIGN 30 TO NA                                                   SDP-0271
C                                                                       SDP-0272
C                                                                       SDP-0273
C     HEADER PREPARATION                                                SDP-0274
C                                                                       SDP-0275
 7    IF (IQUD -2) 8, 9, 11                                             SDP-0276
 8    IDH = LNGA + 100                                                  SDP-0277
      GO TO 10                                                          SDP-0278
 9    IDH = LNGA                                                        SDP-0279
 10   CONTINUE                                                          SDP-0280
B     DG = 450000000000                                                 SDP-0281
B     DK = 660000000000                                                 SDP-0282
      GO TO 23                                                          SDP-0283
 11   IF (IQUD - 4) 12,13, 15                                           SDP-0284
 12   IDH = LNGA + 100                                                  SDP-0285
      GO TO 14                                                          SDP-0286
 13   IDH = LNGA                                                        SDP-0287
 14   CONTINUE                                                          SDP-0288
```

```
B      DG = 620000000000                                                SDP-0289
B      DK = 660000000000                                                SDP-0290
       GO TO 23                                                         SDP-0291
  15   IF (IQUD - 6) 16, 17, 19                                         SDP-0292
  16   IDH = LNGA                                                       SDP-0293
       GO TO 18                                                         SDP-0294
  17   IDH = LNGA + 100                                                 SDP-0295
  18   CONTINUE                                                         SDP-0296
B      DG = 450000000000                                                SDP-0297
B      DK = 250000000000                                                SDP-0298
       GO TO 23                                                         SDP-0299
  19   IF (IQUD - 8) 20, 21, 21                                         SDP-0300
  20   IDH = LNGA                                                       SDP-0301
       GO TO 22                                                         SDP-0302
  21   IDH = LNGA + 100                                                 SDP-0303
  22   CONTINUE                                                         SDP-0304
B      DG = 620000000000                                                SDP-0305
B      DK = 250000000000                                                SDP-0306
C                                                                       SDP-0307
  23   CRUZ = CRUZR                                                     SDP-0308
       STAT = STATR                                                     SDP-0309
       EXC  = EXID                                                      SDP-0310
       DPTH = DEPTHR                                                    SDP-0311
       PAWT = PAWTR                                                     SDP-0312
C                                                                       SDP-0313
  24   WRITE OUTPUT TAPE ITW, 801, CRUZ, STAT, EXC, SMPLR, MO, DA, YR,  SDP-0314
      1LATA, LATB, LATC,  DG, IDH, LNGB, LNGC,  DK, DEPTHR, CRLN        SDP-0315
C                                                                       SDP-0316
  25   GO TO NB, (1 ,35)                                                SDP-0317
C                                                                       SDP-0318
B 30   IF (EXORF(STATR,STAT)) 100,31,100                                SDP-0319
  31   IF (DPTH - DEPTHR)100, 32, 100                                   SDP-0320
B 32   IF (EXORF(EXC,EXID)) 100,33,100                                  SDP-0321
B 33   IF (EXORF(CRUZR,CRUZ)) 100,34,100                                SDP-0322
C                                                                       SDP-0323
  34   GO TO NC, (35 ,50)                                               SDP-0324
C                                                                       SDP-0325
  35   KK = 1                                                           SDP-0326
       K  = 2                                                           SDP-0327
C                                                                       SDP-0328
C      CHECK IF FRACTION PERCENTAGE AND FRACTION WEIGHT ON FIRST CARD   SDP-0329
C      OF EACH SAMPLE IS ZERO. IF NOT PREPARE ERROR STATEMENT NO.1990.  SDP-0330
C                                                                       SDP-0331
  36   IF (PRCTR) 38, 37, 38                                            SDP-0332
  37   IF (FRWTR) 38, 39, 38                                            SDP-0333
C                                                                       SDP-0334
  38   ASSIGN 1990 TO N2                                                SDP-0335
       PHI (K) = -12.00                                                 SDP-0336
```

```
      GO TO 40                                                          SDP-0337
   39 PHI (K) = PHIR                                                    SDP-0338
   40 PHIA = PHIR                                                       SDP-0339
      PRCT (K) = PRCTR                                                  SDP-0340
      ACPC (K) = 0.0                                                    SDP-0341
      T(K) = -4.090                                                     SDP-0342
      FRWT(K) = FRWTR                                                   SDP-0343
      SUMPC  = 0.0                                                      SDP-0344
      SUMWT  = 0.0                                                      SDP-0345
   41 ASSIGN 50 TO NC                                                   SDP-0346
   42 GO TO 1                                                           SDP-0347
   50 KK = KK + 1                                                       SDP-0348
      K = K + 1                                                         SDP-0349
      PHI (K) = PHIR                                                    SDP-0350
      IF (FRWTR) 52, 53, 52                                             SDP-0351
   52 PRCTR = (FRWTR / PAWT) * 100.0                                    SDP-0352
      SUMWT = SUMWT + FRWTR                                             SDP-0353
   53 PRCT (K) = PRCTR                                                  SDP-0354
      SUMPC = SUMPC + PRCTR                                             SDP-0355
      ACPC (K) = SUMPC                                                  SDP-0356
      FRWT(K) = FRWTR                                                   SDP-0357
C                                                                       SDP-0358
C     CALCULATE  T-VALUE                                                SDP-0359
C                                                                       SDP-0360
C     IF SUMPC EQUALS OR LARGER THAN 100 SET  T TO 4.090                SDP-0361
C                                                                       SDP-0362
   60 IF (SUMPC - 100.0) 62, 61, 61                                     SDP-0363
   61 T (K) = 4.090                                                     SDP-0364
      GO TO 77                                                          SDP-0365
C                                                                       SDP-0366
   62 DLPC = SUMPC - 50.0                                               SDP-0367
      IF (DLPC) 64, 63, 65                                              SDP-0368
   63 T (K) = 0.0                                                       SDP-0369
      GO TO 77                                                          SDP-0370
C                                                                       SDP-0371
   64 GMPC = -DLPC                                                      SDP-0372
      GO TO 66                                                          SDP-0373
   65 GMPC = DLPC                                                       SDP-0374
   66 DO 69  L = 1, 100                                                 SDP-0375
      IF (TBLPC (L) - GMPC) 69, 70, 71                                  SDP-0376
   69 CONTINUE                                                          SDP-0377
   70 TCALC = TBLT (L)                                                  SDP-0378
      GO TO 72                                                          SDP-0379
   71 TCALC =   (GMPC - TBLPC (L-1))*(TBLT (L) - TBLT (L-1))/(TBLPC (L) SDP-0380
     2 - TBLPC (L-1))  + TBLT (L- 1)                                    SDP-0381
      IF (TCALC - 4.090) 72,72,61                                       SDP-0382
   72 IF (DLPC) 73, 74, 74                                              SDP-0383
   73 TCALC = -TCALC                                                    SDP-0384
```

```
 74    T (K) = TCALC
C
C
C      CHECK FOR INCORRECT ORDER OF PHI SIZE.
C
 75    IF (PHIA - PHIR) 77, 76, 76
 76    ASSIGN 1666 TO N2
 77    PHIA = PHIR
       GO TO 1
C
C      LAST DETAIL CARD READ SO BEGIN CALCULATIONS
C
C      SUMPC MUST BE BETWEEN 99.94 AND 100.06 OR SAMPLE IS REJECTED.
C
C
  100 IF(SUMPC-99.94)1500,101,101
  101 IF(SUMPC-100.06)102,102,1500
  102 GO TO N2,(103,1666,1990)
C
C      1500 MEANS ACCUMULATED PERCENT NOT WITHIN 0.06 OF 100 PERCENT
C
 103   WRITE OUTPUT TAPE ITW, 802
       KJK = KK + 1
       WRITE OUTPUT TAPE ITW, 8022, ((PHI(J), PRCT(J), ACPC(J)), J=2,KJK)
C
       SUMNL = ACPC (KK)
C
C      IF SUMNL IS LESS THAN 72.00, BY-PASS ALL CALCULATIONS EXCEPT
C      SANS-SILT-CLAY RELATIONSHIP.
C
C
       IF (SUMNL - 72.00) 104, 105, 105
 104   ASSIGN  392 TO NSSC
       WRITE OUTPUT TAPE ITW, 809, PHI(KK)
       GO TO  300
 105   IF (4 - KK) 111, 106, 106
C
C
 106   WRITE OUTPUT TAPE ITW, 815, KK
       GO TO 901
C
C      PREPARE TO INTERPOLATE PHI AT THE 5 PERCENT LEVEL
C
 111   ASSIGN 1105 TO NINT
       XPC = 5.00
       XT  = -1.645
       METAA= 10
       METBB = 20
```

```
      META = 0                                                          SDP-0433
      METB = 0                                                          SDP-0434
      GO TO 150                                                         SDP-0435
C                                                                       SDP-0436
 1105 PHI5 = YY                                                         SDP-0437
C                                                                       SDP-0438
C     PREPARE TO INTERPOLATE PHI AT THE  16 PERCENT LEVEL               SDP-0439
C                                                                       SDP-0440
 112  ASSIGN 1116 TO NINT                                               SDP-0441
      XPC = 16.00                                                       SDP-0442
      XT  = -.995                                                       SDP-0443
      METAA=  1                                                         SDP-0444
      METBB=  2                                                         SDP-0445
      GO TO 150                                                         SDP-0446
C                                                                       SDP-0447
 1116 PHI16 = YY                                                        SDP-0448
C                                                                       SDP-0449
C     PREPARE TO INTERPOLATE PHI AT THE  25 PERCENT LEVEL               SDP-0450
C                                                                       SDP-0451
 113  ASSIGN 1125 TO NINT                                               SDP-0452
      XPC = 25.00                                                       SDP-0453
      XT  = -.674                                                       SDP-0454
      METAA = 0                                                         SDP-0455
      METBB = 0                                                         SDP-0456
      META = 10000                                                      SDP-0457
      METB = 20000                                                      SDP-0458
      GO TO 150                                                         SDP-0459
C                                                                       SDP-0460
 1125 PHI25 = YY                                                        SDP-0461
C                                                                       SDP-0462
C     PREPARE TO INTERPOLATE PHI AT THE  50 PERCENT LEVEL               SDP-0463
C                                                                       SDP-0464
 114  ASSIGN 1150 TO NINT                                               SDP-0465
      XPC = 50.00                                                       SDP-0466
      XT  = 00.00                                                       SDP-0467
      META = 1000                                                       SDP-0468
      METB = 2000                                                       SDP-0469
      GO TO 150                                                         SDP-0470
C                                                                       SDP-0471
 1150 PHI50 = YY                                                        SDP-0472
C                                                                       SDP-0473
C     PREPARE TO INTERPOLATE PHI AT THE 75 PERCENT LEVEL                SDP-0474
C                                                                       SDP-0475
 115  ASSIGN 1175 TO NINT                                               SDP-0476
      XPC = 75.00                                                       SDP-0477
      XT  = .674                                                        SDP-0478
      META = 100                                                        SDP-0479
      METB = 200                                                        SDP-0480
```

```
      GO TO 150
C
 1175 PHI75 = YY
C
C     PREPARE TO INTERPOLATE PHI AT THE 84 PERCENT LEVEL
C
 116  ASSIGN 1184 TO NINT
      XPC = 84.00
      XT  =   .995
      META = 10
      METB = 20
      GO TO 150
C
 1184 PHI84 = YY
C
C     PREPARE TO INTERPOLATE PHI AT THE 95 PERCENT LEVEL
C
      ASSIGN 1195 TO NINT
      XPC = 95.00
      XT  = 1.645
      META = 1
      METB = 2
      GO TO 150
C
 1195 PHI95 = YY
C
 118  WRITE OUTPUT TAPE ITW, 803, PHI5 , PHI16, PHI25, PHI50, PHI75,
     1 PHI84, PHI95, METT, MET
      GO TO 300
C
C     BEFORE THIS POINT IF ACNL LESS THAN 72, SAMPLE HAS BEEN REJECTED
C     BEFORE INTERPOLATION
C     FIND PERCENT JUST LARGER THAN PERCENT LEVEL IN QUESTION
C
 150  DO 151  L = 1, 100
C
      IF (ACPC(L) - XPC) 151, 152, 153
 151  CONTINUE
C
 152  YY = PHI (L)
      GO TO 210
C
  153 IF(XPC-75.00)154,155,157
  154  IF(3-L)195,196,196
C
  155  IF(SUMNL-75.00)167,156,156
  156  IF(L-KK)195,195,196
C
```

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  157  IF(XPC-84.00)158,158,159                                          SDP-0529
  158  IF(SUMNL-84.00)168,156,156                                        SDP-0530
C                                                                        SDP-0531
  159  IF(SUMNL-95.00)169,156,156                                        SDP-0532
C                                                                        SDP-0533
C                                                                        SDP-0534
C      PREPARE TO EXTRAPOLATE  PHI AT THE  75 PERCENT LEVEL              SDP-0535
C                                                                        SDP-0536
 167   ASSIGN 1275 TO NINT                                               SDP-0537
       XT = 0.674                                                        SDP-0538
       META = 300                                                        SDP-0539
       METB = 400                                                        SDP-0540
       GO TO 197                                                         SDP-0541
C                                                                        SDP-0542
 1275  PHI75 = YY                                                        SDP-0543
       WRITE OUTPUT TAPE ITW, 8031, PHI5 , PHI16, PHI25, PHI50, PHI75,   SDP-0544
      1 METT,MET                                                         SDP-0545
       ASSIGN 615 TO NFAW                                                SDP-0546
       GO TO 300                                                         SDP-0547
C                                                                        SDP-0548
C      PREPARE TO EXTRAPOLATE PHI AT 84 PERCENT LEVEL                    SDP-0549
C                                                                        SDP-0550
 168   IF (SUMNL - 81.00) 171, 172, 172                                  SDP-0551
C                                                                        SDP-0552
 171   ASSIGN  505 TO NINM                                               SDP-0553
       WRITE OUTPUT TAPE ITW, 8031, PHI5 , PHI16, PHI25, PHI50, PHI75,   SDP-0554
      1 METT,MET                                                         SDP-0555
       GO TO 300                                                         SDP-0556
C                                                                        SDP-0557
 172   ASSIGN 1284 TO NINT                                               SDP-0558
       XT = 0.995                                                        SDP-0559
       META = 30                                                         SDP-0560
       METB = 40                                                         SDP-0561
       GO TO 197                                                         SDP-0562
C                                                                        SDP-0563
 1284  PHI84 = YY                                                        SDP-0564
       WRITE OUTPUT TAPE ITW, 8032, PHI5 , PHI16, PHI25, PHI50, PHI75,   SDP-0565
      1 PHI84, METT, MET                                                 SDP-0566
       ASSIGN 615 TO NFAW                                                SDP-0567
       GO TO 300                                                         SDP-0568
C                                                                        SDP-0569
C      PREPARE TO EXTRAPOLATE PHI AT THE  95 PERCENT LEVEL               SDP-0570
C                                                                        SDP-0571
 169   IF (SUMNL - 92.00) 174, 175, 175                                  SDP-0572
C                                                                        SDP-0573
 174   ASSIGN  615 TO NFAW                                               SDP-0574
       WRITE OUTPUT TAPE ITW, 8032, PHI5 , PHI16, PHI25, PHI50, PHI75,   SDP-0575
      1 PHI84, METT,MET                                                  SDP-0576
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```
      GO TO 300                                                         SDP-0577
C                                                                       SDP-0578
 175  ASSIGN 1295 TO NINT                                               SDP-0579
      XT = 1.645                                                        SDP-0580
      META = 3                                                          SDP-0581
      METB = 4                                                          SDP-0582
      GO TO  197                                                        SDP-0583
C                                                                       SDP-0584
 1295 PHI95 =YY                                                         SDP-0585
      WRITE OUTPUT TAPE ITW, 8033, PHI5 , PHI16, PHI25, PHI50, PHI75,   SDP-0586
     1   PHI84, PHI95, METT,MET                                         SDP-0587
      GO TO 300                                                         SDP-0588
C                                                                       SDP-0589
 195  X1 = T (L-2)                                                      SDP-0590
      X2 = T (L-1)                                                      SDP-0591
      X3 = T (L)                                                        SDP-0592
      X4 = T (L+1)                                                      SDP-0593
      Y1 = PHI (L-2)                                                    SDP-0594
      Y2 = PHI (L-1)                                                    SDP-0595
      Y3 = PHI (L)                                                      SDP-0596
      Y4 = PHI (L+1)                                                    SDP-0597
      LMT=22                                                            SDP-0598
      GO TO 199                                                         SDP-0599
C                                                                       SDP-0600
 196  X1 = T (L-1)                                                      SDP-0601
      X2 = T (L)                                                        SDP-0602
      X3 = T (L+1)                                                      SDP-0603
      X4 = T (L+2)                                                      SDP-0604
      Y1 = PHI (L-1)                                                    SDP-0605
      Y2 = PHI (L)                                                      SDP-0606
      Y3 = PHI (L+1)                                                    SDP-0607
      Y4 = PHI (L+2)                                                    SDP-0608
      LMT=13                                                            SDP-0609
      GO TO 199                                                         SDP-0610
C                                                                       SDP-0611
 197  X1 = T (L-3)                                                      SDP-0612
      X2 = T (L-2)                                                      SDP-0613
      X3 = T (L-1)                                                      SDP-0614
      X4 = T (L)                                                        SDP-0615
      Y1 = PHI (L-3)                                                    SDP-0616
      Y2 = PHI (L-2)                                                    SDP-0617
      Y3 = PHI (L-1)                                                    SDP-0618
      Y4 = PHI (L)                                                      SDP-0619
      LMT=31                                                            SDP-0620
C                                                                       SDP-0621
 199  X11 = T (L -1)                                                    SDP-0622
      X22 = T (L)                                                       SDP-0623
      Y11 = PHI (L-1)                                                   SDP-0624
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      Y22 = PHI (L)                                                      SDP-0625
C                                                                        SDP-0626
      X = XT                                                             SDP-0627
C                                                                        SDP-0628
C     AITKENS FOUR POINT INTERPOLATION                                   SDP-0629
C                                                                        SDP-0630
 200  P12 =   ( (Y1 * (X2 - X)) - (Y2 * (X1 -X)))/(X2 - X1)              SDP-0631
      P13 =   ( (Y1 * (X3 - X)) - (Y3 * (X1 -X)))/(X3 - X1)              SDP-0632
      P14 =   ( (Y1 * (X4 - X)) - (Y4 * (X1 -X)))/(X4 - X1)              SDP-0633
C                                                                        SDP-0634
      P123 = ((P12 * (X3 - X)) - (P13 * (X2 - X)))/(X3 - X2)             SDP-0635
      P124 = ((P12 * (X4 - X)) - (P14 * (X2 - X)))/(X4 - X2)             SDP-0636
C                                                                        SDP-0637
      YYA =  ((P123 * (X4 -X)) - (P124 * (X3 - X)))/(X4 - X3)            SDP-0638
C                                                                        SDP-0639
C     LINEAR INTERPOLATION                                               SDP-0640
C                                                                        SDP-0641
 201  YYL =   (X - X11) * (Y22 - Y11) / (X22 - X11)   + Y11              SDP-0642
C                                                                        SDP-0643
      YYT =  YYA - YYL                                                   SDP-0644
      IF(YYT) 202, 206, 203                                              SDP-0645
 202  YYT = -YYT                                                         SDP-0646
 203  IF (YYT - 0.20) 204, 204,207                                       SDP-0647
 204  IF (YYA - Y22) 205, 207, 207                                       SDP-0648
 205  IF (Y11 - YYA) 206, 207, 207                                       SDP-0649
 206  YY = YYA                                                           SDP-0650
      METT= METT+ METAA                                                  SDP-0651
      MET = MET + META                                                   SDP-0652
      GO TO 210                                                          SDP-0653
 207  YY = YYL                                                           SDP-0654
      METT= METT+ METBB                                                  SDP-0655
      MET = MET + METB                                                   SDP-0656
C                                                                        SDP-0657
 210  GO TO NINT, (1105,1116,1125,1150,1175,1184,1195,1275,1284,1295)    SDP-0658
C                                                                        SDP-0659
C     CALCULATE SAND, SILT, CLAY RELATIONSHIPS                           SDP-0660
C                                                                        SDP-0661
 300  IF (PHI( KJK  ) - (-1.0)) 305, 301, 301                            SDP-0662
 301  DO 302 KG = 2, KJK                                                 SDP-0663
      IF (ABSF(PHI(KG) - (-1.0)) - .0001) 303, 303, 3022                 SDP-0664
 3022 IF (PHI(KG) - (-1.0)) 302, 303, 304                                SDP-0665
 302  CONTINUE                                                           SDP-0666
 303  GRSN = ACPC(KG)                                                    SDP-0667
      GO TO 307                                                          SDP-0668
 304  GRSN = 0.0                                                         SDP-0669
      RATIO = 9999.99                                                    SDP-0670
      GO TO 307                                                          SDP-0671
 305  SAND = 0.0                                                         SDP-0672
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```
      SILT = 0.0
      CLAY  = 0.0
      NCLAS = 1
      GO TO 380
C
 307  IF (PHI( KJK  ) - 4.0) 312, 308, 308
 308  DO 309  KS = 2, KJK
      IF (ABSF(PHI(KS) - 4.0) - .0001) 310, 310, 3099
 3099 IF (PHI(KS) - 4.0) 309, 310, 311
 309  CONTINUE
 310  SAND = ACPC(KS)
      SANDP = SAND -  GRSN
       FMUD = SUMPC - SAND
      RATIO = SAND/FMUD
      GO TO 313
C
 311  SAND = 0.0
      SANDP = 0.0
      RATIO = 9999.99
      GO TO 313
 312  SAND = SUMPC - GRSN
      SANDP = SAND
      RATIO = 9999.99
      SILT  = 0.0
      CLAY = 0.0
      NCLAS = 1
      GO TO 380
C
 0313 IF (ABSF(PHI(KJK) - 8.0) - .0001) 314, 314, 3177
 3177 IF (PHI( KJK  ) - 8.0) 317, 314, 314
 314  DO 315  KSL = 2, KJK
      IF (ABSF(PHI(KSL) - 8.0) - .0001) 316, 316, 3155
 3155 IF (PHI(KSL) - 8.0) 315, 316, 316
 315  CONTINUE
 316  SILT = ACPC(KSL) - SAND
      CLAY = SUMPC - SAND - SILT
      GO TO 320
 317  SILT = SUMPC - SAND
      CLAY = 0.0
C
C     DETERMINE POSITION OF SAMPLE IN SHEPPARD DIAGRAM.
C
C
 320  IF (SAND - 75.00) 322, 321, 321
 321  NCLAS = 1
      GO TO 380
 322  IF (SILT - 75.00) 324, 323, 323
 323  NCLAS = 4
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      GO TO 380                                                         SDP-0721
  324 IF (CLAY - 75.00) 326, 325, 325                                   SDP-0722
  325 NCLAS = 10                                                        SDP-0723
      GO TO 380                                                         SDP-0724
C                                                                       SDP-0725
  326 IF (SAND - 20.00) 330, 327, 327                                   SDP-0726
  327 IF (SILT - 20.00) 340, 328, 328                                   SDP-0727
  328 IF (CLAY - 20.00) 350, 329, 329                                   SDP-0728
  329 NCLAS = 6                                                         SDP-0729
      GO TO 380                                                         SDP-0730
C                                                                       SDP-0731
  330 IF (CLAY/SILT - 1.) 336, 331, 332                                 SDP-0732
  331 NCLASS = 1                                                        SDP-0733
  332 IF (SAND / SILT - 1.) 333, 334, 335                               SDP-0734
  333 NCLAS = 9                                                         SDP-0735
      GO TO 380                                                         SDP-0736
  334 NCLASS = 1                                                        SDP-0737
  335 NCLAS  = 8                                                        SDP-0738
      GO TO 380                                                         SDP-0739
C                                                                       SDP-0740
  336 IF (CLAY / SAND  - 1.) 337, 338, 339                              SDP-0741
  337 NCLAS = 3                                                         SDP-0742
      GO TO 380                                                         SDP-0743
  338 NCLASS = 1                                                        SDP-0744
      GO TO 380                                                         SDP-0745
  339 NCLAS = 7                                                         SDP-0746
      GO TO 380                                                         SDP-0747
C                                                                       SDP-0748
  340 IF (CLAY / SAND - 1.) 342, 341, 332                               SDP-0749
  341 NCLASS = 1                                                        SDP-0750
      GO TO 332                                                         SDP-0751
C                                                                       SDP-0752
  342 IF (CLAY / SILT - 1.) 343, 344, 345                               SDP-0753
  343 NCLAS = 2                                                         SDP-0754
      GO TO 380                                                         SDP-0755
  344 NCLASS = 1                                                        SDP-0756
      GO TO 380                                                         SDP-0757
  345 NCLAS = 5                                                         SDP-0758
      GO TO 380                                                         SDP-0759
C                                                                       SDP-0760
  350 IF (SAND / SILT - 1.) 336, 351, 342                               SDP-0761
  351 NCLASS = 1                                                        SDP-0762
      GO TO 342                                                         SDP-0763
C                                                                       SDP-0764
  380 WRITE OUTPUT TAPE ITW, 804                                        SDP-0765
  381 IF (RATIO - 9999.99) 382, 383, 382                                SDP-0766
  382 IF (NCLASS) 385, 384, 385                                         SDP-0767
  383 IF (NCLAS) 386, 387, 386                                          SDP-0768
```

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C                                                                       SDP-0769
 384  WRITE OUTPUT TAPE ITW, 8041, GRSN, SANDP, SILT, CLAY, SUMPC,      SDP-0770
     1 RATIO, NCLAS                                                     SDP-0771
      GO TO 390                                                         SDP-0772
 385  WRITE OUTPUT TAPE ITW, 8042, GRSN, SANDP, SILT, CLAY, SUMPC,      SDP-0773
     1 RATIO, NCLAS,NCLASS                                              SDP-0774
      GO TO 390                                                         SDP-0775
 386  WRITE OUTPUT TAPE ITW, 8043, GRSN, SANDP, SILT, CLAY, SUMPC,      SDP-0776
     1 NCLAS                                                            SDP-0777
      GO TO 390                                                         SDP-0778
 387  WRITE OUTPUT TAPE ITW, 8044, GRSN, SANDP, SILT, CLAY, SUMPC,      SDP-0779
     1 NCLAS, NCLASS                                                    SDP-0780
 390  NCLASS = 0                                                        SDP-0781
 391  GO TO NSSC, (392, 400)                                            SDP-0782
 392  WRITE OUTPUT TAPE ITW, 8051                                       SDP-0783
      GO TO 700                                                         SDP-0784
C                                                                       SDP-0785
C     CALCULATE TRASK VALUES                                            SDP-0786
C                                                                       SDP-0787
D400  Q1 = 2.**(-PHI25)                                                 SDP-0788
D     Q2 = 2.**(-PHI50)                                                 SDP-0789
D     Q3 = 2.**(-PHI75)                                                 SDP-0790
C                                                                       SDP-0791
      SO =  SQRTF (Q1 / Q3)                                             SDP-0792
      FLGSO = LOG10F(SO)                                                SDP-0793
      SKG = SQRTF((Q1 * Q3)/(Q2 * Q2))                                  SDP-0794
C                                                                       SDP-0795
      WRITE OUTPUT TAPE ITW, 805, Q1, Q2, Q3, SO, FLGSO, SKG            SDP-0796
C                                                                       SDP-0797
 401  GO TO NTRSK, (500, 901)                                           SDP-0798
C                                                                       SDP-0799
C     CALCULATE INMAN VALUES                                            SDP-0800
C                                                                       SDP-0801
 500  GO TO NINM, (501, 505)                                            SDP-0802
 501  FIMD = (PHI16 + PHI84) / 2.0                                      SDP-0803
      FIDV = (PHI84 - PHI16) / 2.0                                      SDP-0804
      FISK = (FIMD - PHI50)/FIDV                                        SDP-0805
C                                                                       SDP-0806
 502  IF (PHI95 - 99.99) 503, 504, 503                                  SDP-0807
 503  F2SK =(((PHI95 + PHI5 )/ 2.0) - PHI50) / FIDV                     SDP-0808
      FIKU = (((PHI95 - PHI5 )/ 2.0) - FIDV) / FIDV                     SDP-0809
C                                                                       SDP-0810
      WRITE OUTPUT TAPE ITW, 806, PHI50, FIMD, FIDV, FISK, F2SK, FIKU   SDP-0811
      GO TO 600                                                         SDP-0812
C                                                                       SDP-0813
 504  WRITE OUTPUT TAPE ITW, 8061, PHI50, FIMD, FIDV, FISK              SDP-0814
      GO TO 600                                                         SDP-0815
C                                                                       SDP-0816
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 505  WRITE OUTPUT TAPE ITW, 8062                                             SDP-0817
      GO TO 700                                                               SDP-0818
C                                                                             SDP-0819
C     CALCULATE FOLK AND WARD VALUES                                          SDP-0820
C                                                                             SDP-0821
 600  GO TO NFAW, (601, 615)                                                  SDP-0822
 601  FMZ = (PHI16 + PHI50 + PHI84) / 3.0                                     SDP-0823
 602  FDEV = (PHI84 - PHI16)/4.0 + (PHI95 - PHI5 )/6.6                        SDP-0824
 603  DO 604  L = 1, 7                                                        SDP-0825
      IF (TLFD(L) - FDEV) 604,605,605                                         SDP-0826
 604  CONTINUE                                                                SDP-0827
 605  IFDTL = ITLFDC(L)                                                       SDP-0828
C                                                                             SDP-0829
 606  FSK  =  (PHI16 + PHI84 -2.0 * PHI50)/(2.0 * (PHI84 - PHI16))  +         SDP-0830
     1 ((PHI5  + PHI95)-(2.0 * PHI50))/(2.0 * (PHI95 - PHI5 ))                SDP-0831
 607  DO 608  L = 1, 7                                                        SDP-0832
      IF (TLFS(L) - FSK) 608,609,609                                          SDP-0833
 608  CONTINUE                                                                SDP-0834
 609  IFSKTL = ITLFSC(L)                                                      SDP-0835
C                                                                             SDP-0836
 610  FKG = (PHI95 - PHI5 ) / (2.44 * (PHI75- PHI25))                         SDP-0837
 611  DO 612  L = 1, 7                                                        SDP-0838
      IF (TLFK(L) - FKG) 612,613,613                                          SDP-0839
 612  CONTINUE                                                                SDP-0840
 613  IFKTL = ITLFKC(L)                                                       SDP-0841
C                                                                             SDP-0842
 614  WRITE OUTPUT TAPE ITW, 807, FMZ, FDEV,IFDTL, FSK,IFSKTL, FKG,IFKTLSDP-0843
      GO TO 700                                                               SDP-0844
C                                                                             SDP-0845
 615  WRITE OUTPUT TAPE ITW, 8071                                             SDP-0846
      GO TO 700                                                               SDP-0847
 700  GO TO 901                                                               SDP-0848
C                                                                             SDP-0849
C     INITIALIZING BLOCK                                                      SDP-0850
C                                                                             SDP-0851
 900  ASSIGN 1 TO NINOT                                                       SDP-0852
      ASSIGN 4 TO NA                                                          SDP-0853
      GO TO 902                                                               SDP-0854
C                                                                             SDP-0855
 901  KKK = KKK + KK                                                          SDP-0856
      KSM = KSM + 1                                                           SDP-0857
C                                                                             SDP-0858
      ASSIGN 2 TO NINOT                                                       SDP-0859
      IF (END - 99999.) 902, 950, 902                                         SDP-0860
 902  ASSIGN  103 TO N2                                                       SDP-0861
      ASSIGN 400 TO NSSC                                                      SDP-0862
      ASSIGN  500 TO NTRSK                                                    SDP-0863
      ASSIGN  501 TO NINM                                                     SDP-0864
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      ASSIGN  601 TO NFAW                                               SDP-0865
      ASSIGN  901 TO NFINL                                              SDP-0866
      ASSIGN 4 TO NA                                                    SDP-0867
      PHI(1)=-12.00                                                     SDP-0868
      PHI75 = 99.99                                                     SDP-0869
      PHI84 = 99.99                                                     SDP-0870
      PHI95 = 99.99                                                     SDP-0871
C                                                                       SDP-0872
      DO 903 K = 1, 100                                                 SDP-0873
      T(K) = 4.090                                                      SDP-0874
 904  ACPC(K) = 999.99                                                  SDP-0875
 903  PHI(K) = 99.99                                                    SDP-0876
C                                                                       SDP-0877
      NCLAS =0                                                          SDP-0878
      NCLASS=0                                                          SDP-0879
      MA = 0                                                            SDP-0880
      MB = 0                                                            SDP-0881
      MBT = 0                                                           SDP-0882
      MC = 0                                                            SDP-0883
      MED = 0                                                           SDP-0884
      K = 0                                                             SDP-0885
      KK = 0                                                            SDP-0886
      ACPC(1) = 00.00                                                   SDP-0887
      MET = 0000000                                                     SDP-0888
      METT= 00                                                          SDP-0889
      GO TO NIMOT,(1,2)                                                 SDP-0890
C                                                                       SDP-0891
 950  WRITE OUTPUT TAPE ITW, 860, KSM, KKK                              SDP-0892
C                                                                       SDP-0893
 951  IF (MBT) 952, 952, 954                                            SDP-0894
 952  IF (MC) 956, 956, 955                                             SDP-0895
C                                                                       SDP-0896
C                                                                       SDP-0897
 954  WRITE OUTPUT TAPE ITW, 863, (CRMB(L), STMB(L), EXMB(L), L = 1,MBT)SDP-0898
      GO TO 952                                                         SDP-0899
C                                                                       SDP-0900
 955  WRITE OUTPUT TAPE ITW, 864, (CRMC(L), STMC(L), EXMC(L), L = 1,MC) SDP-0901
C                                                                       SDP-0902
 956  MTT = MBT + MC + MED                                              SDP-0903
      IF (MTT) 958, 958, 959                                            SDP-0904
C                                                                       SDP-0905
 958  WRITE OUTPUT TAPE ITW, 861                                        SDP-0906
      GO TO 960                                                         SDP-0907
  959 WRITE OUTPUT TAPE ITW, 865, MTT                                   SDP-0908
 960  TIMY = TIMEF(X) - TO                                              SDP-0909
      WRITE OUTPUT TAPE 6, 7333, TIMY                                   SDP-0910
 7333 FORMAT(1H1, F10.3)                                                SDP-0911
      CALL EXIT                                                         SDP-0912
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C                                                                        SDP-0913
 1500 WRITE OUTPUT TAPE ITW, 830, PAWT                                   SDP-0914
C                                                                        SDP-0915
      KJK = KK + 1                                                       SDP-0916
C                                                                        SDP-0917
 1501 WRITE OUTPUT TAPE ITW, 831                                         SDP-0918
      WRITE OUTPUT TAPE ITW, 833, (PHI(J), FRWT(J), PRCT(J), ACPC(J),    SDP-0919
     1 T(J), J = 2, KJK)                                                 SDP-0920
 1503 WRITE OUTPUT TAPE ITW, 8333, SUMWT                                 SDP-0921
 1504 MED = MED + 1                                                      SDP-0922
 8333 FORMAT (1H0,29X,24HSUM FRACTION WEIGHTS =   F8.3,6H GRAMS    )     SDP-0923
      GO TO 901                                                          SDP-0924
C                                                                        SDP-0925
 1666 WRITE OUTPUT TAPE ITW, 8666                                        SDP-0926
      CRMB(MBT) = CRUZ                                                   SDP-0927
      STMB(MBT) = STAT                                                   SDP-0928
      EXMB(MBT) = EXC                                                    SDP-0929
      GO TO 1501                                                         SDP-0930
 8666 FORMAT (1H0 28X, 40H CARDS OUT OF ORDER. CHECK VALUES BELOW.     ) SDP-0931
 1990 WRITE OUTPUT TAPE ITW, 8990                                        SDP-0932
      CRMC(MC) = CRUZ                                                    SDP-0933
      STMB(MC) = STAT                                                    SDP-0934
      EXMC(MC) = EXC                                                     SDP-0935
      GO TO 1501                                                         SDP-0936
 8990 FORMAT (1H0 28X, 36HNO ZERO PERCENT CARD. WHERE IS IT.          /  SDP-0937
     1 29X, 20H CHECK VALUES BELOW.           )                          SDP-0938
C                                                                        SDP-0939
C     LIST OF FORMAT STATEMENTS                                          SDP-0940
C                                                                        SDP-0941
 801  FORMAT (1H1, 37X, 8H CRUISE , A5, 3X, 9H STATION , A3,  9H   EX IDSDP-0942
     1 , A2 // 29X, 14H SAMPLER TYPE , A2,  7H  DATE , A2, 1H/, A2, 1H/,SDP-0943
     2 A2,         7H  LAT. , I2, 1H-, I2, 1H., I1, A1, 9H   LONG. ,I3,SDP-0944
     3     1H-, I2, 1H., I1, A1 /  29X, 24H DEPTH FROM TOP OF CORE ,F5.0SDP-0945
     4,5H MM. , 16H LENGTH OF CORE ,F5.0, 5H MM.  )                      SDP-0946
 802  FORMAT (1H0, 48X, 28H PHI    FRACTION  ACCUMULATED  /             SDP-0947
     1             49X, 28H SIZE    PERCENT    PERCENT    // )           SDP-0948
 8022 FORMAT (      48X,     F6.2,    F8.2,      F12.2)                  SDP-0949
 803  FORMAT (1H0, 28X, 31H PHI SIZES AT PERCENT LEVEL OF    33X,  7H METSDP-0950
     1HOD / 29X, 71H    5          16         25        50        75      84  SDP-0951
     2    95       USED // 30X, F5.2, 6F9.2, 4X, I2, I5)                 SDP-0952
 8031 FORMAT (1H0, 28X, 71H PHI SIZES AT PERCENT LEVEL OF    (75 LEVEL EXSDP-0953
     2TRAPOLATED)         METHOD  /29X,70H   5         16        25       5SDP-0954
     30       75                          USED //30X, F5.2, 4F9.2,14X, I2SDP-0955
     4, I5)                                                              SDP-0956
C                                                                        SDP-0957
 8032 FORMAT (1H0, 28X, 71H PHI SIZES AT PERCENT LEVEL OF    (84 LEVEL EXSDP-0958
     2TRAPOLATED)         METHOD  /29X,71H   5         16        25       5SDP-0959
     30       75        84                USED //30X, F5.2, 5F9.2, 4X, I2SDP-0960
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     4, I5)                                                                   SDP-0961
C                                                                             SDP-0962
 8033 FORMAT (1H0, 28X, 71H PHI SIZES AT PERCENT LEVEL OF    (95 LEVEL EXSDP-0963
     2TRAPOLATED)        METHOD  /29X,70H  5        16       25      5SDP-0964
     30       75        84       95         USED //30X, F5.2, 6F9.2, 4X, I2SDP-0965
     4, I5)                                                                   SDP-0966
 804  FORMAT (1H0, 28X, 32H SAND, SILT, CLAY RELATIONSHIPS  /                SDP-0967
     2              30X, 66H  GRAVEL       SAND      SILT      CLAY     TOTAL SDP-0968
     3  SAND/MUD      CLASS        )                                          SDP-0969
C                                                                             SDP-0970
 8041 FORMAT (1H0, 29X, F8.2, 5F 9.2, 8X, I1, I4)                            SDP-0971
C                                                                             SDP-0972
 8042 FORMAT (1H0, 29X, F8.2, 5F 9.2, 8X, I1, 1X, I1, I4)                    SDP-0973
C                                                                             SDP-0974
 8043 FORMAT (1H0, 29X, F8.2, 4F 9.2, 14X, I1, I4)                           SDP-0975
C                                                                             SDP-0976
 8044 FORMAT (1H0, 28X, F8.2, 4F 9.2, 14X, I1, 1X, I1, I4)                   SDP-0977
C                                                                             SDP-0978
 805  FORMAT (1H0, 28X, 13H TRASK VALUES / 29X, 51H    Q1         Q2         SDP-0979
     1Q3         SO      LOG SO      SKG // 30X, F6.3, 4F9.3, F8.2 )         SDP-0980
 806  FORMAT (1H0, 28X, 13H INMAN VALUES / 31X, 56H MEDIAN    MEAN       DSDP-0981
     1EV.      SKEW.     2ND SKEW.     KURT.// 32X, F5.2, 3F9.2, 2F11.2)     SDP-0982
 8061 FORMAT (1H0, 28X, 64H INMAN VALUES    (COULD NOT CALCULATE 2ND SKEWSDP-0983
     1NESS AND KURTOSIS) / 29X, 35H MEDIAN      MEAN        DEV.      SKEW.//SDP-0984
     2 30X, F5.2, 3F9.2)                                                      SDP-0985
 8062 FORMAT (1H0, 28X, 55H INMAN PLUS FOLK AND WARD VALUES NOT CALCULATSDP-0986
     1ED BECAUSE / 29X, 50H NEXT TO LAST ACCUMULATED PERCENT WAS LESS THSDP-0987
     2AN 84 )                                                                 SDP-0988
 8051 FORMAT (1H0, 28X, 55H NOT ABLE TO CALCULATE TRASK, INMAN, OR FOLK SDP-0989
     1AND WARD  / 29X,  56H VALUES BECAUSE NEXT TO LAST ACCUMULATED PERCSDP-0990
     2ENT DIN NOT / 29X,10H EXCEED 72)                                        SDP-0991
 807  FORMAT (1H0, 28X, 21H FOLK AND WARD VALUE  / 31X, 53H MEAN         DSDP-0992
     1EV.  TYPE        SKEW.  TYPE     KURT.  TYPE //31X, F5.2, F11.2, 3X, ISDP-0993
     21, F11.2, 4X, I1, F10.2, 4X,I1)                                         SDP-0994
 8071 FORMAT (1H0, 28X, 55H COULD NOT CALCULATE FOLK AND WARD VALUES BECSDP-0995
     1AUSE NEXT / 29X,  47H TO LAST ACCUMULATED PERCENT DID NOT EXCEED   SDP-0996
     292 )                                                                    SDP-0997
 809  FORMAT (1H0, 28X, 42H DID NOT INTERPOLATE ANY PHI SIZES BECAUSE  /SDP-0998
     1  28X, 23H ACCUMULATED PERCENT AT , F5.2, 15H DID NOT EXCEED  /    SDP-0999
     2  28X, 11H 72PERCENT. )                                                 SDP-1000
 815  FORMAT(1H ,28X, 6H ONLY ,I3, 26H DETAIL CARDS SO ONLY SAND,    /     SDP-1001
     1 29X,37H SILT, CLAY RELATIONSHIPS CALCULATED.   )                      SDP-1002
 830  FORMAT (1H0, 28X, 64H   SUM OF FRACTION WEIGHTS DID NOT EQUAL POSTSDP-1003
     1 ANALYTICAL WEIGHT  / 31X, 11H WHICH WAS , F8.3, 39H . CHECK THE VSDP-1004
     2ALUES BELOW FOR ERRORS.    )                                            SDP-1005
C                                                                             SDP-1006
 831  FORMAT (1H0, 40X, 37H PHI  FRACTION  FRACTION  ACCUM.  T-     /     SDP-1007
     1                41X,38H SIZE  WEIGHT    PERCENT   PRCT  VALUE   / ) SDP-1008
```

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C      DECIMAL PLACEMENT     XX.XX  XXX.XXX    XX.XX   XX.XX XX.XXX       SDP-1009
C                                                                          SDP-1010
  833  FORMAT (1H0, 40X, F5.2, F9.3, F9.2, F8.2, F7.3)                     SDP-1011
C                                                                          SDP-1012
  850  FORMAT (A5, A3, 5A2, I2, I2, I1, I2, I2, I1, 2I1, F5.0, A5, F5.2,  SDP-1013
     1 2F5.3, F2.0,1X, F2.0, F5.0, 9X, F5.0)                               SDP-1014
C                                                                          SDP-1015
  860  FORMAT (1H1, 29X, 42H THIS BATCH OF CARDS CONTAINED DATA FROM  ,   SDP-1016
     2 I4,  9H SAMPLES  / 30X, 17H FOR A TOTAL OF  ,I4,  7H CARDS. )      SDP-1017
C                                                                          SDP-1018
  861  FORMAT (1H0, 29X  64H CONGRATULATIONS    NO ERRORS WERE FOUND IN TSDP-1019
     2HIS BATCH OF CARDS.  )                                               SDP-1020
C                                                                          SDP-1021
C                                                                          SDP-1022
  863  FORMAT (1H0, 28X, 44H CARDS OUT OF ORDER ON THE FOLLOWING SAMPLES/SDP-1023
     2 30X,30H CRUISE     STATION     EXID   // 33X, A5, A3, A2   )       SDP-1024
C                                                                          SDP-1025
  864  FORMAT (1H0, 28X, 50H NO ZERO PERCENT CARDS ON THE FOLLOWING STATISDP-1026
     1ONS  /  30X, 30H CRUISE     STATION     EXID // 33X, A5, A3, A2)    SDP-1027
C                                                                          SDP-1028
  865  FORMAT(1H0, 28X, 30H SORRY OLD CHAP, BUT YOU MADE , I3,           SDP-1029
     1 20H ERRORS ON THE DATA / 29X, 41H FOR THIS RUN. NEXT TIME BE MORESDP-1030
     2 CAREFUL )                                                           SDP-1031
       END                                                                 SDP-1032
```

APPENDIX 5 <u>Listing of the Moment Measure Program</u>

```
C       MOMENTS PROGRAM FOR GEOLOGY SECTION
C        PROGRAM NUMBER 0214
C       PREPARED BY MONIQUE R. RONA
C
C
        DIMENSION PHI(100), FRWT(100), PRCT(100), ACPC(100),
       1        X(100), F(100), U(100), UF(100), U2(100), U2F(100),
       2U3(100), U3F(100), U4(100), U4F(100), V(10), FM(10), FMR(10),
       3FMC(10), CMR(10)
C
        ITR = 5
        ITW = 6
        TO = TIMEF(Y)
C
 700    KK = 1
        ASSIGN 103 TO N2
        ASSIGN 35 TO NC
        FRWTR = 0.0
        PAWTR = 0.0
C
 1      READ INPUT TAPE ITR, 850, CRUZR, STATR, SMPLR, EXID, MO, DA, YR,
       1LATA, LATB, LATC, LNGA, LNGB, LNGC, IQUD, ITYP, DEPTHR, PHIR,
       2PRCTR, FRWTR, PAWTR, FRTH, PATH, CRLN, END
C
 850    FORMAT (A5, A3, 5A2, I2, I2, I1, I2, I2, I1, 2I1, F5.0, A5, F5.2,
       1 2F5.3, F2.0,1X, F2.0, F5.0, 9X, F5.0)
C
        FRWTR = FRWTR + (FRTH * 100.)
        PAWTR = PAWTR + (PATH * 100.)
        PHIR = (BTSNUF (PHIR)) * .001
        IF (KK - 1) 30, 7, 30
C
C       HEADER PREPARATION
C
 7      IF (IQUD -2) 8, 9, 11
 8      IDH = LNGA + 100
        GO TO 10
 9      IDH = LNGA
 10     CONTINUE
B       DG = 450000000000
B       DK = 660000000000
        GO TO 23
 11     IF (IQUD - 4) 12,13, 15
 12     IDH = LNGA + 100
        GO TO 14
 13     IDH = LNGA
 14     CONTINUE
B       DG = 620000000000
```

```
B       DK = 660000000000                                               MOM-0049
        GO TO 23                                                        MOM-0050
 15     IF (IQUD - 6) 16, 17, 19                                        MOM-0051
 16     IDH = LNGA                                                      MOM-0052
        GO TO 18                                                        MOM-0053
 17     IDH = LNGA + 100                                                MOM-0054
 18     CONTINUE                                                        MOM-0055
B       DG = 450000000000                                               MOM-0056
B       DK = 250000000000                                               MOM-0057
        GO TO 23                                                        MOM-0058
 19     IF (IQUD - 8) 20, 21, 21                                        MOM-0059
 20     IDH = LNGA                                                      MOM-0060
        GO TO 22                                                        MOM-0061
 21     IDH = LNGA + 100                                                MOM-0062
 22     CONTINUE                                                        MOM-0063
B       DG = 620000000000                                               MOM-0064
B       DK = 250000000000                                               MOM-0065
C                                                                       MOM-0066
 23     CRUZ = CRUZR                                                    MOM-0067
        STAT = STATR                                                    MOM-0068
        EXC    = EXID                                                   MOM-0069
        DPTH = DEPTHR                                                   MOM-0070
        PAWT = PAWTR                                                    MOM-0071
C                                                                       MOM-0072
 24     WRITE OUTPUT TAPE ITW, 801, CRUZ, STAT, EXC, SMPLR, MO, DA, YR, MOM-0073
       1LATA, LATB, LATC,  DG, IDH, LNGB, LNGC,  DK, DEPTHR, CRLN      MOM-0074
C                                                                       MOM-0075
 801    FORMAT (1H1, 37X, 8H CRUISE , A5, 3X, 9H STATION , A3,  9H   EX IDMOM-0076
       1 , A2 // 29X, 14H SAMPLER TYPE , A2,  7H  DATE , A2, 1H/, A2, 1H/,MOM-0077
       2 A2,          7H  LAT. , I2, 1H-, I2, 1H., I1, A1, 9H   LONG. ,I3,MOM-0078
       3     1H-, I2, 1H., I1, A1 /  29X, 24H DEPTH FROM TOP OF CORE ,F5.0MOM-0079
       4,5H MM. , 16H LENGTH OF CORE ,F5.0, 5H MM.  )                  MOM-0080
C                                                                       MOM-0081
        IF (KK - 1) 35, 30, 30                                          MOM-0082
C                                                                       MOM-0083
B 30    IF (EXORF(STATR,STAT)) 100,31,100                               MOM-0084
 31     IF (DPTH - DEPTHR)100, 32, 100                                  MOM-0085
B 32    IF (EXORF(EXC,EXID)) 100,33,100                                 MOM-0086
B 33    IF (EXORF(CRUZR,CRUZ)) 100,34,100                               MOM-0087
C                                                                       MOM-0088
 34     GO TO NC, (35 ,50)                                              MOM-0089
C                                                                       MOM-0090
 35     KK = 1                                                          MOM-0091
        K  = 2                                                          MOM-0092
 36     IF (PRCTR) 38, 37, 38                                           MOM-0093
 37     IF (FRWTR) 38, 39, 38                                           MOM-0094
C                                                                       MOM-0095
 38     ASSIGN 1990 TO N2                                               MOM-0096
```

```
      PHI (K) = -12.00                                                   MOM-0097
      GO TO 40                                                           MOM-0098
C                                                                        MOM-0099
 39   PHI (K) = PHIR                                                     MOM-0100
 40   PHIA = PHIR                                                        MOM-0101
      PRCT (K) = PRCTR                                                   MOM-0102
      ACPC (K) = 0.0                                                     MOM-0103
      FRWT(K) = FRWTR                                                    MOM-0104
      SUMPC  = 0.0                                                       MOM-0105
      SUMWT  = 0.0                                                       MOM-0106
 41   ASSIGN 50 TO NC                                                    MOM-0107
 42   GO TO 1                                                            MOM-0108
C                                                                        MOM-0109
 50   KK = KK + 1                                                        MOM-0110
      K = K + 1                                                          MOM-0111
      PHI (K) = PHIR                                                     MOM-0112
      IF (FRWTR) 52, 53, 52                                              MOM-0113
C                                                                        MOM-0114
 52   PRCTR = (FRWTR / PAWT) * 100.0                                     MOM-0115
      SUMWT = SUMWT + FRWTR                                              MOM-0116
 53   PRCT (K) = PRCTR                                                   MOM-0117
      SUMPC = SUMPC + PRCTR                                              MOM-0118
      ACPC (K) = SUMPC                                                   MOM-0119
      FRWT(K) = FRWTR                                                    MOM-0120
C                                                                        MOM-0121
 75   IF (PHIA - PHIR) 77, 76, 76                                        MOM-0122
 76   ASSIGN 1666 TO N2                                                  MOM-0123
 77   PHIA = PHIR                                                        MOM-0124
      GO TO 1                                                            MOM-0125
C                                                                        MOM-0126
C     LAST DETAIL CARD READ SO BEGIN CALCULATIONS                        MOM-0127
C                                                                        MOM-0128
 100  IF(SUMPC-99.94)1500,101,101                                        MOM-0129
  101 IF(SUMPC-100.06)102,102,1500                                       MOM-0130
  102 GO TO N2,(103,1666,1990)                                           MOM-0131
C                                                                        MOM-0132
C     1500 MEANS ACCUMULATED PERCENT NOT WITHIN 0.06 OF 100 PERCENT      MOM-0133
C                                                                        MOM-0134
 103  WRITE OUTPUT TAPE ITW, 802                                         MOM-0135
 802  FORMAT (1H0, 48X, 28H PHI   FRACTION  ACCUMULATED  /               MOM-0136
     1              49X, 28H SIZE   PERCENT    PERCENT   // )            MOM-0137
      KJK = KK + 1                                                       MOM-0138
      WRITE OUTPUT TAPE ITW, 8022, ((PHI(J), PRCT(J), ACPC(J)), J=2,KJK)MOM-0139
 8022 FORMAT (     48X,     F6.2,     F8.2,     F12.2)                   MOM-0140
C                                                                        MOM-0141
      SUMNL = ACPC (KK)                                                  MOM-0142
 110  WRITE OUTPUT TAPE 6, 111                                           MOM-0143
 111  FORMAT(1H0)                                                        MOM-0144
```

```
      GO TO 200                                                         MOM-0145
C                                                                       MOM-0146
 1666 WRITE OUTPUT TAPE ITW, 8666                                       MOM-0147
 8666 FORMAT (1H0 28X, 40H CARDS OUT OF ORDER. CHECK VALUES BELOW.     ) MOM-0148
      GO TO 700                                                         MOM-0149
 1500 WRITE OUTPUT TAPE ITW, 830, PAWT                                  MOM-0150
 830  FORMAT (1H0, 28X, 64H    SUM OF FRACTION WEIGHTS DID NOT EQUAL POSTMOM-0151
     1 ANALYTICAL WEIGHT  / 31X, 11H WHICH WAS , F8.3, 39H . CHECK THE VMOM-0152
     2ALUES BELOW FOR ERRORS.    )                                       MOM-0153
      GO TO 700                                                         MOM-0154
 1990 WRITE OUTPUT TAPE ITW, 8990                                       MOM-0155
 8990 FORMAT (1H0 28X, 36HNO ZERO PERCENT CARD. WHERE IS IT.        /   MOM-0156
     1  9X, 30H CHECK VALUES BELOW.             )                       MOM-0157
      GO TO 700                                                         MOM-0158
C                                                                       MOM-0159
C     MOMENTS CALCULATIONS                                              MOM-0160
C                                                                       MOM-0161
 200  N = KK                                                            MOM-0162
      NMAX = 20                                                         MOM-0163
      DO 113 I = 1,N                                                    MOM-0164
 113  F(I) = PRCT(I)                                                    MOM-0165
      NNN = N                                                           MOM-0166
      U(1) = -(N/2)                                                     MOM-0167
      M = N/2                                                           MOM-0168
      NN = (N/2) * 2                                                    MOM-0169
      IF (NN - N) 114, 115, 114                                         MOM-0170
C                                                                       MOM-0171
 114  NNN = NNN + 1                                                     MOM-0172
 115  DO   116 I = 2,NNN                                                MOM-0173
 116  U(I) = U(I-1) + 1.0                                               MOM-0174
      N = N - 1                                                         MOM-0175
      DO 117  I = 1,N                                                   MOM-0176
      X(I) = 0.5 * (PHI(I) + PHI(I+1))                                  MOM-0177
 117  F(I) = F(I+1)                                                     MOM-0178
C                                                                       MOM-0179
      SUM = 0.0                                                         MOM-0180
      DO 118  I = 1,N                                                   MOM-0181
 118  SUM = SUM + F(I)                                                  MOM-0182
C                                                                       MOM-0183
      DO 119  I = 1,N                                                   MOM-0184
      UF(I) = U(I) * F(I)                                               MOM-0185
      U2(I) = U(I) ** 2                                                 MOM-0186
      U2F(I) = U2(I) * F(I)                                             MOM-0187
      U3(I) = U2(I) * U(I)                                              MOM-0188
      U3F(I) = U3(I) * F(I)                                             MOM-0189
      U4(I) = U2(I) ** 2                                                MOM-0190
 119  U4F(I) = U4(I) * F(I)                                             MOM-0191
C                                                                       MOM-0192
```

```
C      CALCULATE V(I)                                                   MOM-0193
C                                                                       MOM-0194
       V(1) = 0.0                                                       MOM-0195
       V(2) = 0.0                                                       MOM-0196
       V(3) = 0.0                                                       MOM-0197
       V(4) = 0.0                                                       MOM-0198
       DO 120 I = 1,N                                                   MOM-0199
       V(1) = V(1) + UF(I)                                              MOM-0200
       V(2) = V(2) + U2F(I)                                             MOM-0201
       V(3) = V(3) + U3F(I)                                             MOM-0202
  120  V(4) = V(4) + U4F(I)                                             MOM-0203
       V(1) = V(1)/SUM                                                  MOM-0204
       V(2) = V(2) /SUM                                                 MOM-0205
       V(3) = V(3)/SUM                                                  MOM-0206
       V(4) = V(4)/SUM                                                  MOM-0207
C                                                                       MOM-0208
C      COMPUTE FIRST DATA MOMENT                                        MOM-0209
C      NOTE THAT IN USUAL CASES XNOT TO BE TAKEN AS MID-VALUE OF X,S    MOM-0210
C                                                                       MOM-0211
       M = NNN/2                                                        MOM-0212
       XNOT = X(M)                                                      MOM-0213
       FM(1) = V(1) + XNOT                                              MOM-0214
C                                                                       MOM-0215
C      COMPUTE SECOND DATA MOMENT                                       MOM-0216
C                                                                       MOM-0217
       FM(2)= V(2) - V(1)**2                                            MOM-0218
C                                                                       MOM-0219
C      COMPUTE THIRD DATA MOMENT                                        MOM-0220
C                                                                       MOM-0221
       FM(3)= V(3) - 3.*V(1)*V(2) + 2.*(V(1)**3)                        MOM-0222
C                                                                       MOM-0223
C      COMPUTE FOURTH DATA MOMENT                                       MOM-0224
C                                                                       MOM-0225
       FM(4)= V(4) - 4.*V(1)*V(3) + 6.*(V(1)**2)*V(2) - 3.*V(1)**4      MOM-0226
C                                                                       MOM-0227
C      CONVERSION OF DATA MOMENTS TO PHI MOMENTS                        MOM-0228
C                                                                       MOM-0229
       WR = 1.0                                                         MOM-0230
       FMR(1) = WR * FM(1)                                              MOM-0231
       FMR(2) = WR**2  * FM(2)                                          MOM-0232
       FMR(3) = WR**3  *FM(3)                                           MOM-0233
       FMR(4) = WR**4  * FM(4)                                          MOM-0234
C                                                                       MOM-0235
C      COMPUTE PHI MEAN                                                 MOM-0236
C                                                                       MOM-0237
       XBAR =FMR(1)                                                     MOM-0238
C                                                                       MOM-0239
C      COMPUTE PHI STANDARD DEVIATION                                   MOM-0240
```

```
C
      ST = SQRTF(FMR(2))
C
C     COMPUTE SKEWNESS (THIRD ALPHA MOMENT)
C
      SKEW =FM(3) /(FM(2)**1.5)
C
C     COMPUTE KURTOSIS (FOURTH ALPHA MOMENT)
C
      FKURT=  FM(4)/ FM(2)**2
C
C     SHEPPARD CORRECTION FOR SECOND DATA MOMENT
C
      FMC(2) = FM(2) - (WR**2 / 12.)
C
C     SHEPPARD CORRECTION FOR FOURTH MOMENT DATA
C
      FMC(4) = FM(4) - (WR**2*FM(2))/2. + (WR**4 * 7./240.)
C
C     CONVERSION OF CORRECTED DATA MOMENTS TO CORRECTED PHI MOMENTS
C
      CMR(2) = WR * FMC(2)
      CMR(4) = WR**2 * FMC(4)
C
C     CORRECTED PHI STANDARD DEVIATION
      STC = SQRTF(FMC(2))
C
C     CORRECTED SKEWNESS
C
      SKEWC =FM(3) /FMC(2)**1.5
C
C     CORRECTED  KURTOSIS
C
      CKURT =FMC(4) /FMC(2)**2
C
C     READY TO PRINT OUTPUT
C
      WRITE OUTPUT TAPE 6, 29,CRUS,ISTA,ID
C
 29   FORMAT(25X,17H MOMENTS CRUISE  A5,6H STA   I3, A6//)
C
      WRITE OUTPUT TAPE 6,121, FM(1)
 121  FORMAT(15X,20H FIRST DATA MOMENT =  F11.3//)
C
      WRITE OUTPUT TAPE 6,122, FM(2)
 122  FORMAT(15X,21H SECOND DATA MOMENT =  F10.3//)
C
      WRITE OUTPUT TAPE 6,123, FM(3)
```

```
 123  FORMAT(15X,20H THIRD DATA MOMENT =  F11.3//)                           MOM-0289
C                                                                            MOM-0290
      WRITE OUTPUT TAPE 6,124, FM(4)                                         MOM-0291
 124  FORMAT(15X,21H FOURTH DATA MOMENT =  F10.3///)                         MOM-0292
C                                                                            MOM-0293
      WRITE OUTPUT TAPE 6, 125                                               MOM-0294
 125  FORMAT(15X,44H CONVERSION OF DATA MOMENTS TO PHI MOMENTS , //)         MOM-0295
C                                                                            MOM-0296
      WRITE OUTPUT TAPE 6,126, (FMR(I), I = 1,4)                             MOM-0297
 126  FORMAT (18X, 4F12.3 ///)                                               MOM-0298
C                                                                            MOM-0299
      WRITE OUTPUT TAPE 6,127, XBAR                                          MOM-0300
 127  FORMAT(15X,11H PHI MEAN =  F7.3//)                                     MOM-0301
C                                                                            MOM-0302
      WRITE OUTPUT TAPE 6,128, ST                                            MOM-0303
 128  FORMAT(15X,27H PHI STANDARD DEVIATION =  F13.3//)                      MOM-0304
C                                                                            MOM-0305
      WRITE OUTPUT TAPE 6,129, SKEW                                          MOM-0306
 129  FORMAT(15X,32H SKEWNESS (THIRD ALPHA MOMENT) =  F8.3//)                MOM-0307
      WRITE OUTPUT TAPE 6,130, FKURT                                         MOM-0308
 130  FORMAT(15X,33H KURTOSIS (FOURTH ALPHA MOMENT) =  F7.3//)               MOM-0309
C                                                                            MOM-0310
      WRITE OUTPUT TAPE 6,131, FMC(2)                                        MOM-0311
 131  FORMAT(15X,45H SHEPPARD CORRECTION FOR SECOND DATA MOMENT = F12.3/MOM-0312
     1/)                                                                     MOM-0313
C                                                                            MOM-0314
      WRITE OUTPUT TAPE 6,132, FMC(4)                                        MOM-0315
 132  FORMAT(15X,45H SHEPPARD CORRECTION FOR FOURTH DATA MOMENT = F12.3/MOM-0316
     1/)                                                                     MOM-0317
C                                                                            MOM-0318
      WRITE OUTPUT TAPE 6, 133                                               MOM-0319
 133  FORMAT (1H 65H CONVERSION OF CORRECTED DATA MOMENTS TO CORRECTED       MOM-0320
     1PHI MOMENTS , ///)                                                     MOM-0321
C                                                                            MOM-0322
      WRITE OUTPUT TAPE 6, 43, CMR(2), CMR(4)                                MOM-0323
 43   FORMAT (18X, 2F12.3//)                                                 MOM-0324
C                                                                            MOM-0325
      WRITE OUTPUT TAPE 6, 44, STC                                           MOM-0326
 44   FORMAT(15X,35H CORRECTED PHI STANDARD DEVIATION =  F7.3//)             MOM-0327
C                                                                            MOM-0328
      WRITE OUTPUT TAPE 6, 45,SKEWC                                          MOM-0329
 45   FORMAT(15X,21H CORRECTED SKEWNESS = F10.3//)                           MOM-0330
C                                                                            MOM-0331
      WRITE OUTPUT TAPE 6, 46, CKURT                                         MOM-0332
 46   FORMAT(15X,21H CORRECTED KURTOSIS = F10.3//)                           MOM-0333
C                                                                            MOM-0334
      WRITE OUTPUT TAPE 6, 47, XNOT                                          MOM-0335
 47   FORMAT (1H  F10.2 //)                                                  MOM-0336
```

```
C                                                      MOM-0337
       TIMY = TIMEF(Y) - TO                            MOM-0338
C                                                      MOM-0339
       WRITE OUTPUT TAPE 6, 566, TIMY                  MOM-0340
 566   FORMAT(1H1, F10.3)                              MOM-0341
       GO TO 700                                       MOM-0342
       END                                             MOM-0343
```

APPENDIX 6 Listing of Subroutine BTSNU

```
*     FAP                                                                   BTSN-001
*BTSNU AND XBTSNU ENABLE FORTRAN TO READ SIGN-OVER-UNITS                    BTSN-002
       COUNT   200                                                          BTSN-003
       ENTRY   BTSNU                                                        BTSN-004
       ENTRY   XBTSNU                                                       BTSN-005
       ENTRY   BTCBZ1                                                       BTSN-006
       TITLE                                                                BTSN-007
*THIS SUBROUTINE IS A JACKET AROUND BTCBZ1 WHICH ALLOWS                     BTSN-008
* FORTRAN PROGRAMS TO READ NUMBERS PUNCHED WITH                             BTSN-009
* SIGN-OVER-UNITS.                                                          BTSN-010
*IT IS A LIBRARY FUNCTION-TYPE SUBROUTINE                                   BTSN-011
BTSNU  STL     FLAG   NONZERO FOR FLOATING                                  BTSN-012
       TRA     *+2                                                          BTSN-013
XBTSNU STZ     FLAG    ZERO FOR FIXED                                       BTSN-014
       SXA     IR2,2                                                        BTSN-015
       SXA     IR4,4                                                        BTSN-016
       STO     SAVE     LEFT-ADJUSTED BCD NUMBER IN AC. 1 TO 6 CHARACTRSBTSN-017
       STO     ACSAVE                                                       BTSN-018
       AXT     36,2      6*I    (INITIAL I=6)                               BTSN-019
       AXT     6,4       INITIAL J=6                                        BTSN-020
       ANA     MASK      SAVE RIGHTMOST CHARACTER                           BTSN-021
       SUB     BLANK     IS IT A BLANK.                                     BTSN-022
       TNZ     FOUND     NO. THEN ITS A NUMBER. GO.                         BTSN-023
       CAL     SAVE      YES, IT WAS A BLANK.                               BTSN-024
       LGR     6         THEN TRY THE NEXT CHARACTER.                       BTSN-025
       SLW     SAVE                                                         BTSN-026
       TNX     ALLBLK,4,1   J=J-1                                           BTSN-027
       TXI     *-7,2,-6   6*I=6*(I-1)                                       BTSN-028
FOUND  SXA     *+4,2     SUPPLY CURRENT 6*I, AND                            BTSN-029
       SXA     *+4,4      SUPPLY CURRENT J                                  BTSN-030
       TSX     BTCBZ1,4   TO CALLING SEQUENCE                               BTSN-031
       AXC     SAVE,1                                                       BTSN-032
       LGR     **        6*I                                                BTSN-033
       AXT     **,2      J                                                  BTSN-034
       TRA     ERROR     ERROR RETURN                                       BTSN-035
       NZT     FLAG      SUCCESSRETURN. BINARY RESULT IN AC                 BTSN-036
       TRA     SHIFT     USER WANTS FIXED POINT                             BTSN-037
       ORA     FLOAT    USER WANTS FLOATING POINT                           BTSN-038
       FAD     FLOAT     ZERO+UNNORMALIZED (B35) FLOATING INTEGER           BTSN-039
IR2    AXT     **,2      LEAVE RESULT IN AC FOR CALLING PROGRAM             BTSN-040
IR4    AXT     **,4                                                         BTSN-041
       TRA     1,4      RETURN                                              BTSN-042
SHIFT  TOV     *+1                                                          BTSN-043
       ALS     18        NUMBER TO DECREMENT                                BTSN-044
       TNO     IR2       OK. NUMBER IS NOT TOO LARGE FOR FORTRAN            BTSN-045
       WTDA    3         ERROR. NUMBER IS TOO LARGE, SO LET USER KNOW       BTSN-046
       RCHA    COM1                                                         BTSN-047
       TRA     WRITE                                                        BTSN-048
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 ERROR WTDA     3         ITTEGITIMATE CHARACTER                     BTSN-049
       RCHA     COM2                                                 BTSN-050
       TRA      WRITE                                                BTSN-051
ALLBLK WTDA     3                                                    BTSN-052
       RCHA     COM3                                                 BTSN-053
       TRA      IR2                                                  BTSN-054
 WRITE WTDA     3         PRINT WHATEVER WAS FED.                    BTSN-055
       RCHA     COM4                                                 BTSN-056
       TRA      IR2                                                  BTSN-057
 COM1  IOCD     MES1,,12                                             BTSN-058
 COM2  IOCD     MES2,,12                                             BTSN-059
 COM3  IOCD     MES3,,8                                              BTSN-060
 COM4  IOCP     MES4,,8                                              BTSN-061
       IOCD     ACSAVE,,1                                            BTSN-062
MES1   BCI      7,1THE NUMBER CONVERTED BY XBTSNU IS TOO LAR         BTSN-063
       BCI      5,GE FOR A FORTRAN-TYPE INTEGER                      BTSN-064
MES2   BCI      7, BTSNU OR XBTSNU WAS FED SOME DATA WHICH           BTSN-065
       BCI      5,WAS NOT STRICTLY NUMERIC BCD                       BTSN-066
MES3   BCI      8, BTSNU OR XBTSNU WAS FED 6 SUCCESSIVE BLANKS       BTSN-067
MES4   BCI      8,  THE (HOPEFULLY) BCD DATA WORD ENCOUNTERED WAS    BTSN-068
ACSAVE PZE                                                           BTSN-069
 FLAG  PZE                                                           BTSN-070
SAVE   PZE                                                           BTSN-071
MASK   OCT      77                                                   BTSN-072
 BLANK OCT      60                                                   BTSN-073
 FLOAT OCT      233000000000                                         BTSN-074
*          BTCBZ1 - CONVERSION OF PACKED ZONED BCD TO BINARY.        BTSN-075
*BTCBZ1 IS A MODIFICATION OF -                                       BTSN-076
*    CBZ  CONVERSION OF PACKED ZONED BCD TO BINARY                   BTSN-077
*STANDARD SHARE BEGIN MACRO                                          BTSN-078
       TITLE                                                         BTSN-079
BTCBZ1 TXL      *+4,,                                                BTSN-080
       AXT ,2                                                        BTSN-081
       AXT ,1                                                        BTSN-082
       TRA 5,4                                                       BTSN-083
       SXA *-2,1                                                     BTSN-084
       SXA *-4,2                                                     BTSN-085
*INITIALIZATION                                                      BTSN-086
       TOV *+1                       TURN OFF AC OVERFLOW INDICATOR  BTSN-087
 CBZ71 TRA      CBZ69    (XEC 1,4 LATER)                             BTSN-088
       CAL 0,1                                                       BTSN-089
       LDQ 1,1                                                       BTSN-090
       XEC 2,4                       LEFT-JUSTIFY SOURCE WORD IN MQ  BTSN-091
       XEC 3,4                       J TO IR2                        BTSN-092
       TIX CBZ5,2,6                  IF J IS GREATER THAN SIX        BTSN-093
*IF J IS NOT GREATER THAN SIX                                        BTSN-094
       PXA                           CLEAR AC                        BTSN-095
       XEC CBZ7T,2                   CONVERT THE FIRST J-1 DIGITS TO BINARY  BTSN-096
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       TXH CBZ6,1,CBZ12T+50  IF ILLEGITIMATE CHARACTER WAS MET            BTSN-097
       SUB CBZ8T,2           REMOVE ACCUMULATED ADDRESS PARTS             BTSN-098
       ARS 15                RIGHT-JUSTIFY BINARY RESULT IN AC            BTSN-099
*DEAL WITH ZONED UNITS DIGIT                                              BTSN-100
CBZ1   STO CBZ15E            PRESERVE RESULT                              BTSN-101
       PXA                   CLEAR AC                                     BTSN-102
       LGL 6                 ZONED DIGIT TO AC                            BTSN-103
       PAC ,1                TO IR1, COMPLEMENTED                         BTSN-104
       XEC CBZ13T,1          EXAMINE FINAL CHARACTER                      BTSN-105
*IF PLUS ZONING FOUND                                                     BTSN-106
       ADD CBZ15E            FORM FINAL BINARY RESULT IN AC               BTSN-107
       TNO CBZ+1             GO TO NORMAL RETURN IF NO OVERFLOW OCCURREDBTSN-108
*ERROR RETURN CAUSED BY OVERFLOW                                          BTSN-109
CBZ2   AXT 1,1               ERROR CODE IS 1                              BTSN-110
CBZ3   SXD CBZ,1                                                          BTSN-111
       TXI CBZ+1,4,1                                                      BTSN-112
*IF MINUS ZONING FOUND                                                    BTSN-113
CBZ4   PXA ,1                NUMERICAL VALUE OF UNITS POSITION TO AC      BTSN-114
       SSM                   MAKE AC NEGATIVE                             BTSN-115
       SUB CBZ15E            FORM FINAL BINARY RESULT IN AC               BTSN-116
       TNO CBZ+1             GO TO NORMAL RETURN IF NO OVERFLOW OCCURREDBTSN-117
       TRA CBZ2              OTHERWISE GO TO APPROPRIATE ERROR RETURN     BTSN-118
*IF J IS GREATER THAN SIX                                                 BTSN-119
CBZ5   STQ CBZ15E            PRESERVE FIRST SIX DIGITS                    BTSN-120
       CAL 1,1                                                            BTSN-121
       LDQ 2,1                                                            BTSN-122
       XEC 2,4               LEFT-JUSTIFY SECOND SOURCE WORD IN MQ        BTSN-123
       CAL CBZ15E                                                         BTSN-124
       STQ CBZ15E            PRESERVE LAST J-6 CHARACTERS                 BTSN-125
       LGR 36                FIRST SIX DIGITS TO MQ, AC CLEARED           BTSN-126
       CAQ CBZ12T,1,6        CONVERT FIRST SIX DIGITS                     BTSN-127
       TXH CBZ6,1,CBZ12T+60  IF ILLEGITIMATE CHARACTER WAS MET            BTSN-128
       SUB CBZ10T-6          REMOVE ACCUMULATED ADDRESS PARTS             BTSN-129
       ARS 15                RIGHT-JUSTIFY BINARY RESULT IN AC            BTSN-130
       STO CBZ16E            PRESERVE IT                                  BTSN-131
       LDQ CBZ11T,2                                                       BTSN-132
       MPY CBZ16E            MULTIPLY BY 10**(J-6)                        BTSN-133
       LLS 35                FORCE DETECTION OF OVERFLOW                  BTSN-134
       LDQ CBZ15E            LOAD LAST J-6 CHARACTERS                     BTSN-135
       STO CBZ15E            PRESERVE PRODUCT                             BTSN-136
       PXA                   CLEAR AC                                     BTSN-137
       XEC CBZ7T,2           CONVERT LAST J-7 DIGITS                      BTSN-138
       TXH CBZ6,1,CBZ12T+50  IF ILLEGITIMATE CHARACTER WAS MET            BTSN-139
       SUB CBZ8T,2           REMOVE ACCUMULATED ADDRESS PARTS             BTSN-140
       ARS 15                RIGHT-JUSTIFY BINARY RESULT IN AC            BTSN-141
       ADD CBZ15E            RESULT OF FIRST CONVERSION                   BTSN-142
       TRA CBZ1              GO TO DEAL WITH ZONED UNITS DIGIT            BTSN-143
*ERROR RETURN CAUSED BY ILLEGITIMATE CHARACTER                            BTSN-144
```

```
CBZ6    AXT 2,1                  ERROR CODE IS 2                        BTSN-145
        TRA CBZ3                                                        BTSN-146
*TABLE  OF CONVERT INSTRUCTIONS FOR LAST CONVERSION                     BTSN-147
        CAQ  CBZ12T,1,5                                                 BTSN-148
        CAQ  CBZ12T+10,1,4                                              BTSN-149
        CAQ  CBZ12T+20,1,3                                              BTSN-150
        CAQ  CBZ12T+30,1,2                                              BTSN-151
        CAQ  CBZ12T+40,1,1                                              BTSN-152
        CAQ  CBZ12T+50,1,0                                              BTSN-153
CBZ7T   BSS 0                                                           BTSN-154
*TABLE  OF ACCUMULATED ADDRESS PARTS IN LAST CONVERT INSTRUCTION        BTSN-155
        DEC      5          FAP FLAGGED A RELOCATION ERROR WHEN         BTSN-156
        DEC      4          TRYING TO ASSEMBLE THE VFD                  BTSN-157
        DEC      3          INSTRUCTIONS HERE.  SO THIS                 BTSN-158
        DEC      2          TABLE IS GENERATED ONCE AT                  BTSN-159
        DEC      1          CBZ69                                       BTSN-160
        DEC      0                                                      BTSN-161
CBZ8T   BSS 0                                                           BTSN-162
*TABLE  OF CONVERT INSTRUCTIONS                                         BTSN-163
        CAQ  CBB7T,1,6                                                  BTSN-164
        CAQ  CBB7T+10,1,5                                               BTSN-165
        CAQ  CBB7T+20,1,4                                               BTSN-166
        CAQ  CBB7T+30,1,3                                               BTSN-167
        CAQ  CBB7T+40,1,2                                               BTSN-168
        CAQ  CBB7T+50,1,1                                               BTSN-169
CBB4T   CAQ CBB7T+60,1,0                                                BTSN-170
*TABLE  OF ACCUMULATED ADDRESS PARTS                                    BTSN-171
        DEC      6          FAP FLAGGED A RELOCATION ERROR WHEN         BTSN-172
        DEC      5          TRYING TO ASSEMBLE THE VFD                  BTSN-173
        DEC      4          INSTRUCTIONS HERE.  SO THIS                 BTSN-174
        DEC      3          TABLE IS GENERATED ONCE AT                  BTSN-175
        DEC      2          CBB69                                       BTSN-176
        DEC      1                                                      BTSN-177
CBB5T   PZE                                                             BTSN-178
*TABLE  OF POWERS OF TEN                                                BTSN-179
        DEC  1000000                                                    BTSN-180
        DEC  100000                                                     BTSN-181
        DEC  10000                                                      BTSN-182
        DEC  1000                                                       BTSN-183
        DEC  100                                                        BTSN-184
        DEC  10                                                         BTSN-185
CBB6T   BSS 0                                                           BTSN-186
*CONVERSION TABLE                                                       BTSN-187
CBB7T   PZE CBB7T+10,,           000000                                 BTSN-188
        PZE CBB7T+10,,12500      100000                                 BTSN-189
        PZE CBB7T+10,,25000      200000                                 BTSN-190
        PON CBB7T+10,,4732       300000                                 BTSN-191
        PON CBB7T+10,,17232      400000                                 BTSN-192
```

```
PON CBB7T+10,,29732    500000                    BTSN-193
PTW CBB7T+10,,9464     600000                    BTSN-194
PTW CBB7T+10,,21964    700000                    BTSN-195
PTH CBB7T+10,,1696     800000                    BTSN-196
PTH CBB7T+10,,14196    900000                    BTSN-197
PZE CBB7T+20,,         00000                     BTSN-198
PZE CBB7T+20,,1250     10000                     BTSN-199
PZE CBB7T+20,,2500     20000                     BTSN-200
PZE CBB7T+20,,3750     30000                     BTSN-201
PZE CBB7T+20,,5000     40000                     BTSN-202
PZE CBB7T+20,,6250     50000                     BTSN-203
PZE CBB7T+20,,7500     60000                     BTSN-204
PZE CBB7T+20,,8750     70000                     BTSN-205
PZE CBB7T+20,,10000    80000                     BTSN-206
PZE CBB7T+20,,11250    90000                     BTSN-207
PZE CBB7T+30,,         0000                      BTSN-208
PZE CBB7T+30,,125      1000                      BTSN-209
PZE CBB7T+30,,250      2000                      BTSN-210
PZE CBB7T+30,,375      3000                      BTSN-211
PZE CBB7T+30,,500      4000                      BTSN-212
PZE CBB7T+30,,625      5000                      BTSN-213
PZE CBB7T+30,,750      6000                      BTSN-214
PZE CBB7T+30,,875      7000                      BTSN-215
PZE CBB7T+30,,1000     8000                      BTSN-216
PZE CBB7T+30,,1125     9000                      BTSN-217
PZE CBB7T+40,,         000                       BTSN-218
PZE CBB7T+40,4,12      100                       BTSN-219
PZE CBB7T+40,,25       200                       BTSN-220
PZE CBB7T+40,4,37      300                       BTSN-221
PZE CBB7T+40,,50       400                       BTSN-222
PZE CBB7T+40,4,62      500                       BTSN-223
PZE CBB7T+40,,75       600                       BTSN-224
PZE CBB7T+40,4,87      700                       BTSN-225
PZE CBB7T+40,,100      800                       BTSN-226
PZE CBB7T+40,4,112     900                       BTSN-227
PZE CBB7T+50,,         00                        BTSN-228
PZE CBB7T+50,2,1       10                        BTSN-229
PZE CBB7T+50,4,2       20                        BTSN-230
PZE CBB7T+50,6,3       30                        BTSN-231
PZE CBB7T+50,,5        40                        BTSN-232
PZE CBB7T+50,2,6       50                        BTSN-233
PZE CBB7T+50,4,7       60                        BTSN-234
PZE CBB7T+50,6,8       70                        BTSN-235
PZE CBB7T+50,,10       80                        BTSN-236
PZE CBB7T+50,2,11      90                        BTSN-237
PZE CBB7T+60,,         0                         BTSN-238
PZE CBB7T+60,1         1                         BTSN-239
PZE CBB7T+60,2         2                         BTSN-240
```

```
         PZE CBB7T+60,3          3                                   BTSN-241
         PZE CBB7T+60,4          4                                   BTSN-242
         PZE CBB7T+60,5          5                                   BTSN-243
         PZE CBB7T+60,6          6                                   BTSN-244
         PZE CBB7T+60,7          7                                   BTSN-245
         PZE CBB7T+60,,1         8                                   BTSN-246
         PZE CBB7T+60,1,1        9                                   BTSN-247
*    THIS PART OF THE CONVERSION TABLE IS ONLY REACHED AFTER A WRONG ...BTSN-248
*    CHARACTER HAS BEEN ENCOUNTERED                                  BTSN-249
         DUP 1,61                                                    BTSN-250
         PZE CBB7T+61                                                BTSN-251
*ERASABLE STORAGE                                                    BTSN-252
CBB8E    BSS 1                   FOR INTERMEDIATE RESULT OF CONVERSION BTSN-253
CBB9E    BSS 1                   FOR MULTIPLIER OF POWER OF TEN      BTSN-254
*TABLES SHARED WITH CBB                                              BTSN-255
CBZ9T    EQU  CBB4T              TABLE OF CONVERT INSTRUCTIONS       BTSN-256
CBZ10T   EQU  CBB5T              TABLE OF ACCUMULATED ADDRESS PARTS  BTSN-257
CBZ11T   EQU  CBB6T              TABLE OF POWERS OF TEN              BTSN-258
CBZ12T   EQU  CBB7T              CONVERSION TABLE                    BTSN-259
*TABLE FOR INTERPRETING ZONED UNITS POSITION                         BTSN-260
*    UNZONED DECIMAL DIGITS ARE LEFT UNCHANGED IN AC                 BTSN-261
         DUP 1,10                                                    BTSN-262
CBZ13T   NOP                                                         BTSN-263
*    ILLEGITIMATE CHARACTERS CAUSE TRANSFER OF CONTROL TO ERROR RETURN BTSN-264
         DUP 1,7                                                     BTSN-265
         TRA CBZ6                                                    BTSN-266
*    ZONING IS REMOVED IN AC FROM PLUS-ZONED DIGITS 1 - 9            BTSN-267
         DUP 1,9                                                     BTSN-268
         SUB CBZ14C                                                  BTSN-269
         PXA                     CLEAR AC IF +0 WAS READ             BTSN-270
*    ILLEGITIMATE CHARACTERS CAUSE TRANSFER OF CONTROL TO ERROR RETURN BTSN-271
         DUP 1,6                                                     BTSN-272
         TRA CBZ6                                                    BTSN-273
*    FOR MINUS-ZONED DIGITS IR1 RECEIVES NUMERICAL VALUES 1 - 9, 0   BTSN-274
         TXI CBZ4,1,34                                               BTSN-275
         TXI CBZ4,1,36                                               BTSN-276
         TXI CBZ4,1,38                                               BTSN-277
         TXI CBZ4,1,40                                               BTSN-278
         TXI CBZ4,1,42                                               BTSN-279
         TXI CBZ4,1,44                                               BTSN-280
         TXI CBZ4,1,46                                               BTSN-281
         TXI CBZ4,1,48                                               BTSN-282
         TXI CBZ4,1,50                                               BTSN-283
         TXI CBZ4,1,42                                               BTSN-284
*    ILLEGITIMATE CHARACTERS CAUSE TRANSFER OF CONTROL TO ERROR RETURN BTSN-285
         DUP 1,21                                                    BTSN-286
         TRA CBZ6                                                    BTSN-287
*GENERATE TABLE OF ACCUMULATED ADDRESS PARTS                         BTSN-288
```

```
 CBZ69 AXT      5,2                                                  BTSN-289
       AXT      CBZ12T+25,1                                          BTSN-290
       TXI      *+1,1,5                                              BTSN-291
       PXA      ,1                                                   BTSN-292
       XCA                                                           BTSN-293
       MPY      CBZ8T-1,2                                            BTSN-294
       STQ      CBZ8T-1,2                                            BTSN-295
       TIX      *-5,2,1                                              BTSN-296
       CLA      CBXEC      REPLACE TSX WITH XEC 1,4                  BTSN-297
       STO      CBZ71                                                BTSN-298
*GENERATE TABLE OF ACCUMULATED ADDRESS PARTS.                        BTSN-299
 CBB69 AXT      6,2                                                  BTSN-300
       AXT      CBB7T+30,1                                           BTSN-301
       TXI      *+1,1,5                                              BTSN-302
       PXA      ,1                                                   BTSN-303
       XCA                                                           BTSN-304
       MPY      CBB5T,2                                              BTSN-305
       STQ      CBB5T,2                                              BTSN-306
       TIX      *-5,2,1                                              BTSN-307
       TRA      CBZ71                                                BTSN-308
 CBXEC XEC      1,4        S TO IR18 COMPLEMENTED.                   BTSN-309
*CONSTANT                                                            BTSN-310
CBZ14C OCT 20                  PLUS ZONING                           BTSN-311
*ERASABLE STORAGE                                                    BTSN-312
CBZ15E EQU CBB8E               FOR INTERMEDIATE RESULT OF CONVERSION BTSN-313
CBZ16E EQU CBB9E               FOR MULTIPLIER OF POWER OF TEN        BTSN-314
CBZMD1 EQU      BTCBZ1                                               BTSN-315
 CBZ   EQU      CBZMD1                                               BTSN-316
FCBZ   EQU      BTSNU                                                BTSN-317
XFCBZ  EQU      XBTSNU                                               BTSN-318
       DETAIL                                                        BTSN-319
       END                                                           BTSN-320
```

## APPENDIX 7 Listing of Subroutine EXORF

```
*      FAP                                                            EXOR-001
*   FORTRAN LIBRARY FUNCTION / EXOR                                   EXOR-002
        COUNT    8                                                    EXOR-003
        LBL      EXOR,X                                               EXOR-004
        ENTRY    EXOR                                                 EXOR-005
        REM      RETURNS THE EXCLUSIVE OR OF TWO ARGUMENTS TO THE     EXOR-006
        REM      ACCUMULATOR.  IT MAY BE USED ONLY IN BOOLEAN STATEMENTS. EXOR-007
 EXOR   STQ      A                                                    EXOR-008
        ERA      A                                                    EXOR-009
        TRA      1,4                                                  EXOR-010
 A      BSS      1                                                    EXOR-011
        END                                                           EXOR-012
```

## APPENDIX 8 Listing of Subroutine XRND

```
*       FAP                                                           XRND-001
C       SUBROUTINE XRND                                               XRND-002
C       FAP SUBROUTINE TO PERFORM THE NEAREST ROUND-OFF.              XRND-003
C                                                                     XRND-004
         COUNT    7                                                   XRND-005
         ENTRY    XRND                                                XRND-006
 XRND    UFA      *+4                                                 XRND-007
         FRN                                                          XRND-008
         ALS      18                                                  XRND-009
         TRA      1,4                                                 XRND-010
         OCT      233000000000                                        XRND-011
         END                                                          XRND-012
```

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